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ABSTRACT

This study attempted to examine dental manpower and variables related to it in Pennsylvania in the context of the national dental manpower. Findings include: (1) Optimum demand, based on dental care for all in the next decade, would require 2,495 additional dentists. (2) Women find a career in dentistry to be very satisfactory but only one-half percent of the dentists in the United States are women. (3) Changing to a 3-year instead of a 4-year dental school curriculum could produce 232 to 320 additional dentists in 1973-80 and meet more than half of the need for more dental manpower. (4) If the water supply were universally flouridated in Pennsylvania, the manpower need for dentists would be reduced, thus providing manpower for improved care. (5) Projected dental manpower needs for Pennsylvania for 1973-80 can be met without increasing dental school facilities by (a) enrolling more Pennsylvania students in Pennsylvania dental schools, thus reducing nonresident admissions, and (b) increasing the use of dental auxiliaries, particularly dental assistants. Related tables are included in the appendices. (Author/PG)

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A Study of Dental Manpower Demand and Supply in Pennsylvania

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A Study of Dental Manpower Demand and Supply in Pennsylvania

Prepared by
Frank M. Durkee
Research Associate
Higher Education Research Section
Division of Research
Bureau of Information Systems
Pennsylvania Department of Education
September 1973

Commonwealth of Pennsylvania
Milton J. Shapp, Governor

Department of Education
John C. Pittenger, Secretary
David W. Hornbeck, Executive Deputy

Bureau of Information Systems
Seon H. Cho, Director

Division of Research
Robert B. Hayes, Director

Higher Education Research Section
Frank M. Durkee, Director

Pennsylvania Department of Education
Box 911
Harrisburg, Pa. 17126

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SUMMARY

This study of dental manpower was done at the request of the Office of Higher Education, Pennsylvania Department of Education.

There is a definite need for more and better dental care. Half the children in this country below the age of two have some form of gum disease or tooth decay. By middle age some 50 million Americans have lost their teeth. There are about one billion untreated cavities per year in this nation. Gaps definitely exist in dental care.

According to the American Dental Association the average waiting time for a dental appointment is about 13 days. Many wait much longer. One person in 10 has never been to a dentist, and this ratio is much higher for the low income groups. Dental costs increased 362 per cent from 1950 to 1970 while personal income increased 209 per cent. About 40 per cent of the nation's people do not have an annual dental examination.

From 1960-70 the number of dentists in Pennsylvania decreased 4.6 per cent while the population increased 4.2 per cent. Distribution is also a problem with 12 counties having more than 3,100 people per dentist while the national ratio is about 1,700 people per dentist. The median age of Pennsylvania dentists is 50.3 while the national median is 45 years.

Minimum dental manpower demand in this state is approximately 2,900 additional licensed dentists for the 1970-80 period. Using projections of graduates by deans of Commonwealth dental schools, the study projects the supply of dentists as 2,690 for the present decade, a minimum shortage of 210 dentists. To assure 10 per cent of optimum dental care for all would require some 250 additional, or a total unmet need of approximately 460 dentists for 1970-80.

The supply of dentists in Pennsylvania could be increased without expansion of facilities by a number of alternatives, used separately or in combination. One way is to increase the percentage of Pennsylvania students in Commonwealth dental schools. Out-of-state students now average 75.8 per cent for the University of Pennsylvania, 38.3 per cent for Temple University and 8.9 per cent for the University of Pittsburgh. Since a New York State study indicated a 78 per cent probability that dental school graduates tend to practice in the same or similar region as their residence prior to their dental education, it is reasonable to believe that recruitment of dental students from dentist-deficient regions, such as planning regions 5, 6, 7 and 9, would make a significant contribution to increasing dental manpower in these regions. Of Pennsylvania dental school graduates, 1962-72, 71.64

per cent became practicing licensed dentists in Pennsylvania. The minimum need for 210 dentists might be met by increasing the percentage of resident graduates from some 57 per cent to about 76 per cent.

If resident graduates were further increased to 85 per cent in Pennsylvania's three dental schools this might take care of the 250 additional dentists needed to provide 10 per cent of optimum dental care for all. With this percentage of resident graduates, 910 additional dental school spaces, 115 annually, would open to Pennsylvania students, 1973-80. This would be an important by-product in view of the fact that applicants to these Commonwealth dental schools increased by 98 per cent, 1962-71, while admissions increased by only 26 per cent.

A second alternative available to meet the need for 460 dentists, 1970-80, is changing from the four-year to the three-year dental education curriculum. This alternative could result in admitting 539 instead of 431 first-year students, 108 more students, an increase in productivity of graduates from 397 to 496 by 1976, and depending on entry rate, increase the supply of dentists by 232 to 320.

Increasing the fluoridation of water supply in the Commonwealth, a third alternative, from the present 44.3 per cent of the population to the national rate of 45.5 per cent could make available 102 dentists, resulting from a per capita decrease in the amount of dental care required. Were fluoridation available for the whole population, the dental manpower thus made available could be as much as 743 dentists, making possible a greater percentage of optimum dental care.

A fourth alternative for increasing Commonwealth dental manpower is the expanded use of dental auxiliaries, particularly dental assistants. Since only 59.5 per cent of Pennsylvania dentists now use dental assistants, a rate 20 per cent below the national average, much room for improvement lies in this area. Since it has been established that the addition of one dental assistant to a traditional dental office can increase dental treatment productivity of a dentist by 33 per cent, such action could, in effect, increase dental manpower. If even one-third of the 3,164 Commonwealth dentists not having a dental assistant would hire one, they would increase their productivity the equivalent of 352 dentists.

Additional increases in the need for dentists and dental auxiliaries could result from emergence of national or state health dental programs or other prepaid plans.

A STUDY OF DENTAL MANPOWER

This study of dental manpower in Pennsylvania included the research of pertinent publications and a survey of deans of Pennsylvania dental schools, and county dental associations. It attempted to examine dental manpower and variables related to it in Pennsylvania in the context of our national dental manpower.

NATIONAL DENTAL MANPOWER

In 1970 there were 120,739 dentists in the United States of whom 102,500 were professionally active. About nine of every ten were in private practice. Of the remainder, 6,800 were commissioned officers in the Armed Forces; about 1,300 had other federal government positions and about 2,000 had full-time positions in schools, hospitals, or State and local health agencies. Women dentists represented about two per cent of the profession.

Concentrated in large cities and populous states, about a third of all dentists were in four states--New York, California, Pennsylvania and Illinois.[1]

Requirements

All states require a license to practice dentistry, and the candidate for a license must be a graduate of an approved dental school and have passed a state board examination. For the written examination, 46 states and the District of Columbia recognize the examination given by the National Board of Dental Examiners. Under the state license, a dentist may have general or specialized practice in most states.

Predental education may be a minimum of two years of college, but 12 of the 52 dental schools require three years of college. Of the dental students enrolled in 1971-72, however, 66.9 per cent had a bachelor's degree and 3 per cent a master's or other degree; all had a Dental School Admissions Test score.

Dental education generally requires four years, but some schools have programs permitting a student to complete the dental program in three years. In Pennsylvania, for example, the University of Pennsylvania Dental School has a multi-track system allowing a student to graduate in three years by advance placement and an accelerated

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[1] Occupational Outlook for College Graduates 1970-71, Bulletin 1681, U.S. Department of Labor, Bureau of Labor Statistics, Washington, D.C., p. 72.

program. While the University of Pittsburgh Dental School emphasizes enrichment, a student can graduate in three calendar years. Temple University inaugurated a three-year dental program four years ago, and about half of the 1972 graduates completed the dental program in three years.

Production of Dental Manpower

Dental school enrollment has increased from 13,580 in 1960 to 17,305 in 1971, or 26.7 per cent. Dental school graduates have increased from 3,253 in 1960 to 3,775 in 1971, or 16 per cent. The average output of graduates, 1960-71, was 3,362, with average class attrition, 1963 class through 1968 class, of 12.3 per cent. Table 1 displays relevant output data, 1960-71.

Projecting the trends of dental manpower system, one finds that the number of dental graduates increases from 3,749 in 1970 to 4,450 in 1980, and that the number of dentists increases from 120,739 in 1970 to 142,416 in 1980. The population to dentist ratio gradually becomes more satisfactory, decreasing from 1,697 people per dentist in 1970 to 1,620 people per dentist in 1980.

Table 2 displays relevant data on projected dental manpower to 1980.

National Demand for Dental Manpower

The U.S. Bureau of Labor Statistics has projected the average annual openings for dentists as 4,900.[2] Comparing this annual demand with the supply of graduates shown in Table 1 and Table 2, it appears that an average annual shortage of 1,443 dentists in 1968 will decrease to 450 in 1980, a total shortage for the period of 12,376 dentists, or an average annual shortage of 952 dentists in the United States, 1968-80.

This national shortage of dentists is projected without any recognition of the increasing need for dental care. The need for more and better dental care is indicated by the fact that among our population there are about one billion cavities--about five per person--untreated each year and the fact that at least 50 million Americans have lost their teeth by middle age. It is further estimated that half the children of the nation below the age of two have some form of gum disease or tooth decay.[3]

Waiting Time for Dental Appointment. Significant to the need for dentists is the average waiting time for a dental appointment. Nationally,

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[2]U.S. Economy in 1980, A Summary of BLS Projections, Bulletin 1683, U.S. Department of Labor, Bureau of Labor Statistics, Washington, D.C.,1970,p. 58.

[3]"New Techniques in Dental Care: Less Painful, More Effective," U.S. News and World Report, April 2, 1973, p. 65 ff.

Table 1

Input and Output of the Dentist-Supply System in the United States, 1960-70

Year	Number Schools	Total Dental School Enrollment	First Year Enrollment[3]	Total Dental School Grads.[2]	Graduates as Per Cent of First Yr. Students	Graduates as Per Cent of Total Enrollment	Attrition Rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1960	47	13,580		3,253			
1961	47	13,513		3,290			
1962	48	13,576		3,207			
1963	48	13,691	3,770	3,233		23.6	
1964	49	13,876	3,836	3,213		23.2	
1965	49	14,020	3,806	3,181		22.7	
1966	49	14,421	3,942	3,198	84.8	23.4	15.2
1967	50	14,955	4,200	3,360	87.6	24.2	12.4
1968	52	15,408	4,203[4]	3,457	90.8	24.7	9.2
1969	53	16,008	4,355[5]	3,433	87.1	23.8	12.9
1970	53	16,553	4,565[5]	3,749	89.3	25.1	10.7
1971	52	17,305	4,745[6]	3,775	86.7	24.5	13.3
Mean		14,742	4,158	3,362	87.7	24.3	12.3

[1]Annual Report on Dental Education 1971-72, American Dental Association, Chicago, Illinois, 1972, p. 21.

[2]Ibid., p. 31.

[3]Applicants to Dental School 1967, American Dental Association, Chicago, Illinois, Table 5 for 1963-67.

[4]Analysis of Applicants to Dental School and First Year Enrollment, 1970, Table 8.

[5]Ibid., 1971.

[6]Op. cit., Annual Report, p. 20.

Table 2

Projections of Number of Dental Graduates, Dentists and Population Per Dentist in the United States, 1971-80

Year	Projected Number Graduates	Projected Number Dentists	U.S. Census Population Projections Series D	United States Population Projections	Population Per Dentist Ratio
1970	3,749	120,739		204,879,000	1,697
Projected*					
1971	3,775	122,816	206,939,000	206,235,000	1,685
1972	3,850	124,816	209,181,000	209,396,000	1,682
1973	3,900	126,916	211,530,000	212,690,000	1,666
1974	3,950	128,916	213,991,000	216,116,000	1,659
1975	4,070	131,016	216,561,000	219,671,000	1,652
1976	4,160	133,316	219,239,000	223,352,000	1,644
1977	4,200	135,516	222,018,000	227,151,000	1,638
1978	4,270	137,816	224,888,000	231,063,000	1,632
1979	4,360	140,116	227,839,000	235,075,000	1,626
1980	4,450	142,416	230,855,000	239,177,000	1,620

*Projections are from Annual Report on Dental Education 1969-70, American Dental Association, Chicago, Illinois, 1970, p. 9 and U.S. Census Bureau Projections, Series P-25, No. 470, p. 12.

the average waiting time for a dental appointment was 13 days in 1970 compared with 13.8 days in 1967, and the waiting time for 22.7 per cent of dental appointments was more than three weeks in 1970 compared with 27.3 per cent in 1967. In the Middle East district, which includes Pennsylvania, the average waiting time for a dental appointment was 11.5 days in 1970 compared with 12 days in 1967, and 19 per cent of the dental patients waited three weeks or more for an appointment in 1970 compared with 21.9 per cent in 1967, while about 5 per cent of patients waited six weeks or more for an appointment. Waiting time for a dental appointment decreased somewhat, 1967 to 1970, but the longer trend, 1961-70, indicates an increasing demand on dentists: 10.6 days in 1961; 11.5 days, 1964; 13.8 days, 1967 and 13 days, 1970--about 22.6 per cent increase, 1961-70. Further details appear in Table 3 and Table 3a.

Interval Between Dental Visits. Another indicator of the need for dental care is the length of time by age group between dental visits. In fact in 1969, 13.3 per cent of the population had never been to a dentist, 13.2 per cent had not been to a dentist in five years or more and 14.2 per cent, two-four years, a total of 40.7 per cent lacking adequate dental care.

Family Income and Dental Care. The interval between dental visits is closely related to family income. The income groups from $3,000 to $9,999 have higher percentages of people in the lower interval groups; in fact, 16.5 per cent of them have never been to a dentist. The increased use of prepaid dental plans and the adoption of a national health insurance plan would largely obviate the influence of family income on dental care, thus increasing the demand for dentists. (Data are displayed in Appendix A).

Cost of Dental Care. A rather good index of demand for dental care is its cost. Table 4 indicates that total dental expenditures increased 362 per cent from 1950 to 1970 while personal income increased 209.1 per cent. At the same time on the Consumer Price Index, dentist fees rose from an index of 63.9 (base year 1967) to 119.4 in 1970 or 55.5 points, with an increase of 27.2 points for the latest period, 1965-70.

Dental expense by age groups in the United States in 1970, displayed in Table 5, both in the number of people who spent no money on dental care and in individual amounts spent, $50 to more than $500, indicates the influence on and impact of costs of dental care on the population in terms of unmet demand and satisfied demand. With 60 per cent of the population of all ages spending no money on dental care, by the simple standard of an annual dental examination, the unmet need for dental care is very great. Of the total population, 25.2 per cent spent less than $50 on dental care; 6.7 per cent, $50-$99, 5.4 per cent, $100-$249; 2.1 per cent, $250-$499 and 0.67 per cent, $500 or more; an average of $74 and a per capita expense of $29. Dental expense varies by age groups as shown in Table 5.

Table 3

Average Waiting Time for a Dental Appointment by Region, 1967;
Percentage Distribution for Nonsalaried Dentists

Region	1-2 Days	3-6 Days	One Week	Two Weeks	Three Weeks	Four Weeks	Five Weeks	Six Weeks or More	Average Number Days
New England	12.7	11.0	17.0	22.0	14.8	9.9	4.4	8.2	16.1
Middle East	14.5	17.1	29.5	17.0	9.2	5.2	2.2	5.3	12.0
Southeast	17.3	18.4	22.1	17.1	8.7	4.8	2.7	8.9	13.1
Southwest	28.6	16.3	26.4	12.9	7.9	1.1	1.7	5.1	9.7
Central	10.1	11.7	22.7	22.3	9.8	8.5	3.8	11.1	16.1
Northwest	11.6	11.0	26.8	23.8	9.2	7.3	1.8	8.5	14.3
Far West	12.5	17.0	22.9	19.4	13.0	6.4	2.2	6.6	13.5
United States	14.0	15.0	24.4	19.3	10.1	6.4	2.8	8.0	13.8

Source: The 1968 Survey of Dental Practice, American Dental Association, Chicago, Illinois, p. 30.

Table 3a

Average Waiting Time for a Dental Appointment by Region, 1970;
Percentage Distribution for Nonsalaried Dentists

Region	1-2 Days	3-6 Days	One Week	Two Weeks	Three or Four Weeks	Five or More Weeks	Average Number Days
New England	12.8	16.1	26.7	20.9	14.7	8.8	13.7
Middle East	18.5	16.6	26.5	19.4	14.2	4.8	11.5
Southeast	16.1	21.1	18.9	18.7	15.3	9.9	13.8
Southwest	24.8	25.7	23.0	13.0	8.1	5.4	9.6
Central	13.6	18.0	20.0	21.6	17.2	9.6	14.4
Northwest	10.8	19.1	23.0	21.6	16.2	9.3	14.3
Far West	14.2	18.8	20.9	24.2	16.1	5.8	12.7
United States	15.8	18.6	22.5	20.4	15.2	7.5	13.0

Source: The 1971 Survey of Dental Practice, American Dental Association, Chicago, Illinois, 1971, p. 39.

Table 4

Increase in Dental Expenditures in Relation to Personal Income in the United States, 1950-1970

Year	U.S. Dental Expenditures[1]	U.S. Personal Income[2]	Dentist Fees and Consumer Price Index[3]	5-Year Increases in Price Index
	(1)	(2)	(3)	(4)
1950	961	227,600	63.9	
1955	1,508	310,900	73.0	9.1
1960	1,977	401,000	82.1	9.1
1965	2,808	538,900	92.2	10.1
1968	3,623	688,900	105.5	
1969	4,047	750,300	112.9	
1970	4,440	803,600	119.4	27.2
Per Cent Change	362.0	209.1		

[1] Statistical Abstract of the United States, 1972, U.S. Department of Commerce, Washington, D.C., p. 66. (Figures in column (1) and column (2) are in millions.)

[2] Ibid., p. 317.

[3] Ibid., p. 65. (In base year, 1967, Consumer Price Index = 100.)

Table 5

Dental Expense by Age Groups in the United States, 1970

	All Ages	Under 17 Years	17-44 Years	45-64 Years	65 Years and Over
Population (Thousands)	200,856	66,716	73,526	41,477	19,138
	Per Cent Distribution				
No expense	60.0	64.5	53.5	57.4	74.8
Less Than $50	25.2	26.3	28.1	23.4	13.7
$ 50-$ 99	6.7	4.7	8.4	7.4	5.2
$100-$249	5.4	3.1	6.9	7.1	4.0
$250-$499	2.1	1.1	2.2	3.4	1.8
$500 or More	0.7	*	0.9	1.2	*
Average Expense	$74	$50	$76	$97	$85
Per Capita Expense	$29	$18	$35	$41	$21

*Unreliable data.

Source: Monthly Vital Statistics Report, U.S. Department of Health, Education, and Welfare, Public Health Service, Rockville, Maryland, 1970.

Comparative costs of dental services in selected states, the United States, under group health insurance, and the Equitable Life Assurance Plan, shown in Appendix B, lend specificity to dental care costs. Though costs in Pennsylvania were not given, those reported for New York State are probably rather representative of the Commonwealth and likely more realistic indicators of costs of dental care than the averages used in Table 5. Some of these costs are: dental examination, $5.25; complete X-rays, $18.80; cleaning, $10.60; single surface silver filling, $8.00; two-surface silver filling, $14.50; simple extraction, $11.25; single root canal, $77.00; three root canal, $151.00; two-tooth fixed bridge, $250.00; four-tooth fixed bridge, $502.00 and full dentures $235.00. For the most part group health dental insurance costs are the lowest, for example, $5.00 for a single surface silver filling; $7.00 for cleaning and $150.00 for full dentures.

Income of Dentists. Income of dentists is indicative of the demand for dental services. The gross income of dentists, shown in Appendix C, for 1967 and 1970 explains the rising costs of dental care based on a demand for services. In 1967, 41.2 per cent of nonsalaried dentists had a gross income from the $31,950-$33,949 range to $71,950 and up. In 1970, in the higher salary ranges, 82.2 per cent of nonsalaried dentists had a gross income from $31,950-$33,949 range to $99,950 and up. In fact, 42.9 per cent of the nonsalaried dentists had income from the $59,950-$69,949 range to $99,950 and up. Of incorporated dentists in 1970, 44.4 per cent had a gross income in the $99,950 and up range.

Mean gross income, mean net income and median net income for nonsalaried dentists in the United States and selected states appear in Table 6 and Table 6a. Mean gross income for nonsalaried dentists in the United States increased from $46,391 in 1967 to $59,325 in 1970 or $2,934 in three years; about 6.3 per cent. In Pennsylvania the increase was from $39,446 in 1967 to $48,509 in 1970 or $9,163, about 23 per cent, or 3.5 times the national increase.

Mean net income for nonsalaried dentists in the United States moved upward from $24,700 to $30,770 in 1970, or $6,030 in three years, about 28.3 per cent. In Pennsylvania the mean net income changed from $23,101 in 1967 to $26,901 in 1970, or $3,800, about 16.4 per cent gain below the United States.

Median net income for nonsalaried dentists in the United States changed $22,850 in 1967 to $28,100 in 1970, or an increase of $5,250, about 23 per cent. In Pennsylvania the median income changed from $21,000 to $26,100, or an increase of $5,100, slightly lower than the national increase, but 24.2 per cent. Comparisons with other states are shown in Table 6 and Table 6a.

Per Capita Income or Sales and Dentist Income. Table 7 displays per capita buying income, per capita retail sales, and dentist mean income for selected states and the United States with the rank order

Table 6

Average Gross and Net Income of Dentists in Pennsylvania, Adjacent States and the United States, 1967

	Nonsalaried Dentists							All Dentists	
	Mean Gross Income	Mean Net Income	Median Net Income	Net as Per Cent of Gross	Standard Deviation	Coefficient of Variation	Standard Error of Mean	Mean Net Income	Median Net Income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Maryland	$50,092	$27,354	$23,983	54.6	$13,862	50.7	$1,100	$24,395	$21,400
Michigan	49,257	25,753	22,970	52.3	12,968	50.4	870	24,891	22,517
New Jersey	43,003	23,817	22,050	55.4	12,165	51.1	1,014	23,398	20,983
New York	45,196	25,034	23,500	55.4	12,877	51.4	628	23,910	22,004
Pennsylvania	39,446	23,101	21,000	58.6	12,590	54.4	976	22,690	20,200
West Virginia	40,004	23,611	20,900	59.0	12,395	52.5	1,319	22,234	19,050
United States	46,391	24,740	22,850	53.3	12,707	51.4	239	23,761	21,455

Source of Data: The 1968 Survey of Dental Practice, American Dental Association, Chicago, Illinois, p. 11.

Table 6a

Average Gross and Net Income of Dentists in Pennsylvania, Adjacent States and the United States, 1970

	Nonsalaried Dentists							All Dentists	
	Mean Gross Income	Mean Net Income	Median Net Income	Net as Per Cent of Gross	Standard Deviation	Coefficient of Variation	Standard Error of Mean	Mean Net Income	Median Net Income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Maryland	$63,861	$33,445	$33,700	52.4	$17,603	52.6	$1,146	$31,984	$29,650
Michigan	61,736	31,072	29,200	50.3	16,992	54.7	1,178	30,342	28,200
New Jersey	60,719	32,316	30,000	53.2	15,558	48.1	1,315	30,962	30,750
New York	58,864	32,108	28,300	54.5	19,818	61.7	921	29,818	26,000
Pennsylvania	48,509	26,901	26,100	55.5	14,397	53.5	1,082	26,414	25,000
West Virginia	45,816	25,344	22,500	55.3	14,503	57.2	1,496	23,750	20,950
United States	59,325	30,770	28,100	51.9	17,541	57.0	289	29,487	26,900

Source of Data: The 1971 Survey of Dental Practice, American Dental Association, Chicago, Illinois, p. 12.

for each. In per capita buying income, the United States had $3,078 in 1969 compared with $3,086 for Pennsylvania, which was lower than such nearby states as Connecticut with $3,694; New York, $3,579; New Jersey, $3,542; Massachusetts, $3,434 and Ohio, $3,1 7. The rank order correlation of per capita buying income with dentist mean income in the sample was r = .80, indicating a strong relationship between per capita buying income and the demand for dental care. In the sample Pennsylvania has a rank of 10 for per mean dentist income and a rank of 11 for per capita buying income, with dentist mean income in nearby states being greater than that in Pennsylvania, ($26,901), e.g., Maryland, $31,984; New Jersey, $30,962; New York, $29,818; Connecticut, $29,415; Ohio, $28,655. Loss of dental graduates to nearby states intensifies the demand for dental manpower in the Commonwealth.

Another economic variable that correlates with mean dentist income is per capita retail sales. Here Pennsylvania has a rank of 12 in the sample, only two ranks from the bottom. The rank order correlation for the sample, r = .15, is quite low compared to that for per capita buying income, making it a much less valid predictor of dentist mean income and dentist manpower demand.

Table 7

Per Capita Buying Income, Sales, Dentist Income and Percentage Change in Population and Number of Dentists in Selected States, 1960-70

	Per Capita Buying Income[1] 1969	Rank	Per Capita Retail Sales[1] 1969	Rank	Dentist Mean Income[2] 1970	Rank	Population Change Per Cent[3] 1969-70	Dentist Change Per Cent 1969-70
New York	$3,579	3	$1,755	10	$29,818	5	8.4	5.3
Massachusetts	3,434	6	1,843	3	24,285	12	2.5	13.3
California	3,514	5	1,901	2	37,702	1	27.0	37.0
Connecticut	3,694	1	1,839	4	29,415	6	12.7	13.7
New Jersey	3,542	4	1,758	8	30,962	3	26.5	16.0
Illinois	3,640	2	1,902	1	28,027	9	10.2	-0.3
Pennsylvania	3,086	11	1,652	12	26,901	10	4.2	-4.6
Michigan	3,279	7	1,791	7	30,342	4	13.4	14.8
Ohio	3,187	9	1,690	11	28,655	8	9.7	8.7
Maryland	3,254	8	1,756	9	31,984	2	-1.0	45.5
Indiana	3,123	10	1,807	5	28,773	7	11.4	5.3
Delaware	2,895	12	1,804	6		0	22.8	36.4
Texas	2,777	13	1,649	13	26,145	11	16.9	37.5
West Virginia	2,294	14	1,260	14	23,750	13	-6.2	-11.4
United States	3,078		1,709		29,487		13.3	15.0

[1]Distribution of Dentists in the United States by State, Region, District and County, American Dental Association, Chicago, Illinois, 1971, p. 4ff. (Per capita buying income = income of individuals - all tax payments.)

[2]Facts About States, American Dental Association, Chicago, Illinois, 1971, p. 9. No data for Delaware.

[3]Ibid., p. 8.

Dental Patient Load. Dental patient load may also be indicative of dental manpower demand. Dental patient load is indicated by both the average number of patients per year per dentist and the average number of patient visits per year per dentist. Number of patients per dentist per year in the United States increased from 1,292 in 1967 to 1,485 in 1970, or 193, representing 14.9 per cent in four years. In the Middle East Region, which includes Pennsylvania, the patient load increased in the same period by 145 or 11.6 per cent.

Average number of patient visits annually to nonsalaried dentists in the United States, 1967-70, increased by 38 or 1.1 per cent. In the Middle East Region, which includes Pennsylvania, the average number of patient visits changed from 3,849 in 1967 to 3,481 in 1970, a decline of 368 patient visits per dentist per year, or 9.5 per cent. Of the seven regions in the United States, five regions showed a drop in the average number of patient visits, but all seven regions indicated an increase in the number of patients, from 27 in the Southwest to 335 in the Northwest (Table 8 and Table 8a).

Increased efficiency in dentistry has made it possible for a dentist to care for more patients in less time per patient. The high speed drill (350,000 RPM), better lighting, segmented dental chairs, new plastics and new resins are some of the factors contributing to efficiency.[4] This helps to explain how the dentists in the United States were able to care for an average of 64 additional patients per year, 1967-70, representing about a five per cent increase in productivity. But in the Middle East Region, which includes Pennsylvania, the average increase in the number of patients per dentist was 48, an increase of about 3.9 per cent in productivity. Clearly, dentist productivity is relevant to dental manpower demand.

Time Given to Patient Appointments. Average amount of time required for dental appointments has a bearing on number of dentists needed for dental care. In 1970, 37.6 per cent of the independent dentists gave the usual appointment as 30 minutes, 17.1 per cent as 45 minutes and 20.3 per cent as one hour. Eleven per cent utilized the 15-20 minute appointment, and three per cent one and one-half hours or more.

Table 9 indicates the distribution of dentists according to length of the usual appointment. In the Middle East Region, 45 per cent of the dentists had a usual appointment of 30 minutes, 7.4 per cent more than the national average. On the other hand, 12.9 per cent of these dentists had one-hour appointments compared with a national average of 20.3 per cent.

As dentists give dental care to each patient in less time, the demand for dental manpower becomes less per 100,000 population. Table 9 follows.

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[4] Op. cit., p. 66.

Table 8

Average Number of Patients Annually--Nonsalaried Dentists--by Region, 1967 and 1970

	Mean No. Patients				Median No. Patients		
	1967	1970	Col. (2)-Col. (1)	Per Cent Change	1967	1970	Col. (6)-Col. (5)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
New England	1,121	1,330	209	18.6	900	1,002	102
Middle East	1,243	1,388	145	11.6	899	997	98
Southeast	1,365	1,539	174	12.7	1,100	1,198	98
Southwest	1,257	1,284	27	02.1	1,100	970	130
Central	1,474	1,631	157	10.7	1,195	1,198	3
Northwest	1,360	1,695	335	24.6	1,000	1,202	202
Far West	1,227	1,432	205	16.7	980	999	19
U.S. Average	1,292	1,485	193	12.4	1,001	1,004	3

Table 8a

Average Number of Patient Visits Annually--Nonsalaried Dentists--by Region, 1967 and 1970

	Mean No. Patient Visits			Mean Annual Visits Per Patient	
	1967	1970	Difference	1967	1970
	(1)	(2)	(3)	(4)	(5)
New England	3,693	3,567	-126	3.3	2.7
Middle East	3,849	3,481	-368	3.1	2.5
Southeast	3,481	4,013	532	2.5	2.6
Southwest	3,077	3,250	173	2.4	2.5
Central	3,699	3,650	- 49	2.5	2.2
Northwest	3,306	3,224	- 82	2.4	2.0
Far West	3,585	3,351	-234	2.9	2.4
U.S. Average	3,527	3,565	38	2.7	2.4

Source: Survey of Dental Practice, 1968 and 1971, American Dental Association, p. 27 and p. 34. (Pennsylvania is in Middle East Region.)

Table 9

Percentage Distribution of Nonsalaried Dentists According to Length of Patient Appointments by Region and for the United States, 1970

Usual length of appointment	New England	Middle East	South-east	South-west	Central	North-west	Far West	United States
15 minutes	5.1	5.2	4.7	2.6	3.8	3.0	3.1	4.1
20 minutes	8.0	9.6	5.7	6.0	2.0	3.4		6.4
30 minutes	45.1	45.0	36.7	35.8	39.5	22.6	26.9	37.6
40 minutes	6.5	5.0	6.4	10.5	6.7	6.9	8.0	6.7
45 minutes	16.0	14.2	16.9	18.3	16.5	26.6	19.9	17.1
1 hour	11.3	12.9	21.5	22.7	19.3	32.5	30.7	20.3
1½ hours	1.1	1.1	2.4	2.2	2.1	4.9	3.1	2.1
2 hours	1.1	0.3	0.5	0.0	0.7	0.5	1.1	0.6
Other	5.8	6.7	5.2	2.2	5.4	2.0	3.8	5.1
Total	100.0	100.0[1]	100.0	100.0	100.0	100.0	100.0	100.0

Source: The 1971 Survey of Dental Practice, American Dental Association, Chicago, 1973, p. 35.

Weekly Office Hours and Salary. The number of hours dentists work per week in relation to income is significant in the manpower demand and supply equation. From 1967 to 1970 the national average work week for dentists changed from 41.7 hours to 41.5 hours, a decrease of about 12 minutes per week in three years. Hours at the dental chair changed from 34.8 in 1967 to 33.2 in 1970, a decrease of 2.6 hours per week. At the same time, as previously shown, dentists' average annual income has greatly increased. This situation implies an increasing demand for dental services, with the dentist, not the consumer, the determiner of the amount and nature of the response.

Tables 10 and 10a indicate the nature of the dentists' work week for gross receipts categories.

Third Party Payments for Dental Care. As with medical care, utilization of dental care services increases as prepaid plans increase in number, for the constraint of the cost of care impinges to a lesser degree on the decision regarding dental care. The number of people under prepaid plans for dental care has increased from 1,006,000 in 1962, 0.5 per cent of the population, to 12,210,000 in 1970, about 6 per cent of the population.[5]

[5] Statistical Abstract of the United States, U.S. Department of Commerce, Washington, D.C., 1972, p. 464.

Table 10

Mean Number of Weekly Office Hours of Nonsalaried Dentists in 1967 by Level of Gross Receipts and Type of Office Activity

Gross Receipts	Hours at the Chair	Hours in the Lab.	Other Hours Work in Office	Free Hours in the Office	Total Hours in Office
-19,999	28.4	4.4	2.5	3.8	39.1
20,000-29,999	33.0	3.8	2.6	2.5	41.9
30,000-39,999	35.0	3.3	2.4	1.6	42.3
40,000-49,999	35.7	2.8	2.6	1.4	42.5
50,000-59,999	36.3	2.3	2.5	1.2	42.3
60,000-69,999	36.0	2.4	3.0	1.2	42.6
70,000-79,999	35.8	2.2	3.1	0.9	42.0
80,000-89,999	35.6	1.7	2.8	1.0	41.1
90,000-99,999	36.4	1.9	3.5	0.7	42.5
100,000-	36.0	1.3	3.3	0.6	41.2
Mean	34.8	2.6	2.8	1.5	41.7

Source: The 1968 Survey of Dental Practice, American Dental Association, Chicago, Illinois, p. 35.

Table 10a

Mean Number of Weekly Office Hours of Nonsalaried Dentists in 1970 by Level of Gross Receipts and Type of Office Activity

Gross Receipts	Hours at the Chair	Hours in the Lab.	Other Hours Work in Office	Free Hours in the Office	Total Hours in Office
19,999	26.1	5.0	2.8	4.2	38.1
20,000-29,999	31.7	4.3	2.7	2.9	41.6
30,000-39,999	33.0	3.6	2.8	2.1	41.5
40,000-49,999	34.3	3.2	2.7	1.6	41.8
50,000-59,999	34.2	3.2	2.9	1.6	41.9
60,000-69,999	34.5	2.5	3.4	1.3	41.7
70,000-79,999	34.9	2.8	3.0	1.6	42.3
80,000-89,999	34.4	2.1	3.4	1.3	41.2
90,000-99,999	34.7	2.1	3.5	1.2	41.5
100,000-	34.2	3.0	5.7	0.9	43.8
Mean	33.2	3.2	3.3	1.9	41.5

Source: The 1971 Survey of Dental Practice, American Dental Association, Chicago, Illinois, p. 45.

Increasing governmental and union sponsorship of prepaid dental care plans promises coverage for a mounting proportion of the population. Concomitantly, demand for dental care continues to increase.

A growing prepaid dental care service is provided in government maternal and child health services programs. Mothers given treatment increased from 32,000 in 1968 to 42,000 in 1970, about 31.2 per cent. Children given treatment increased from 1,332,000 in 1968 to 1,406,000 in 1969.[6] Topical fluoride applications increased from 439,000 in 1968 to 474,000 in 1970, or 7.9 per cent. Early dental care for children promotes healthy teeth and in the long term can reduce the demand on dentist time.

Fluoridation of Water Supply. The impact of fluoridation of the water supply on dental health of children and hence on dental manpower demand has been well established. Cleveland public schools reported findings for school children from 1955-56 to 1962-63:[7]

	Perfect Teeth	Dental Caries	Tooth Loss
1955-56	27.9%	3.4%	.29%
1962-63	59.3%	1.3%	.07%
Improvement	112.5%	61.8%	75.9%

A reduction of almost two-thirds in dental caries of the children is highly significant to dental manpower as well as dental health. The Cleveland results were corroborated in many states. In Evanston, Illinois, the dental caries rate was 101.54 per 100 children, 6-8 years old in 1946; by 1960, after use of fluoride, the dental caries rate was 43.55, a decrease of 69.9 per cent.[8] In Grand Rapids, Michigan the decrease in dental caries was 65 per cent. In Colorado Springs with natural fluoride water the 20-44 age group showed a dental caries rate of 60 per cent below the national norm.

More recently a health writer emphasized the importance of fluoride in this statement:

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[6] Ibid., p. 303.

[7] Healy, Thomas F. "Study of the Effects of Fluoride on Teeth of Children in the Cleveland Public Schools, Cleveland, Ohio 1963," excerpted in Dental Abstracts, May 1964.

[8] Journal of the American Dental Association, Special Issue on Foundation, January 1967.

> Fluoridation programs costing ten million dollars reduce caries in three hundred thousand children; the same money put into the treatment rather than the prevention of caries would affect something less than fifty thousand children.[9]

Nationwide, 45.5 per cent of the population has the benefit of fluoridation. Among the states the proportion of the population benefiting from fluoridation ranges from 2.5 per cent in Utah to 84.4 per cent in Illinois; others, Rhode Island, 80.7 per cent; Maryland,76 per cent; Colorado, 73.3 per cent; Connecticut, 72.6 per cent.[10] In Pennsylvania the proportion of the population having fluoridated water is 5,226,896, or 44.3 per cent, a little below the national average.

Dental Auxiliaries. One way of getting optimum productivity from skilled professionals is that of using trained auxiliary personnel. In the United States in 1970, 79.2 per cent of the dentists used full-time dental assistants; 21.8 per cent part-time assistants; 34.8 per cent used full-time secretaries and receptionists; 7.2 per cent, part-time secretaries and assistants; 15.8 per cent used full-time dental hygienists; 15.4 per cent, part-time dental hygienists. Not many dentists employ dental technicians: 4.3 per cent employ full-time dental technicians; 1.9 per cent part-time dental technicians.

In Pennsylvania in 1970, 59.5 per cent of the dentists employed full-time dental assistants, almost 20 per cent below the national average; 21 per cent employed part-time dental assistants; 19.5 per cent employed secretaries and full-time receptionists, 15.3 below the national average; 6.5 per cent employed part-time secretaries and receptionists; 16 per cent employed full-time dental hygienists, about same as national average, but only 8.5 per cent employed part-time dental hygienists, 6.9 per cent below the national average; 2 per cent employed dental technicians, 2.3 per cent below the national average; 1.5 per cent employed part-time dental technicians.

Table 11 gives the percentages of dentists using each kind of auxiliary in states adjacent to Pennsylvania.

U.S. Senator Warren D. Magnuson's legislation for training 30,000 dental auxiliaries "only slows growing deficits in hygienists and dental assistants." [11]

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[9]Carlson, Rich J. "Health in America," The Center Magazine, November/December 1972, pp. 43-47.

[10]Statistical Abstract of the United States, U.S. Department of Commerce, Washington, D.C., 1972, p. 173.

[11]"Can You Afford to Have Teeth," by Gerald Astor, Esquire Magazine, February 1973, p. 127.

Table 11

Percentage of Independent Dentists Employing Auxiliary Personnel in Selected States, 1970

	Hygienists		Technicians		Assistants		Secretaries & Receptionists	
	FT	PT	FT	PT	FT	PT	FT	PT
Maryland	12.8	16.9	2.8	1.2	78.7	26.1	39.0	9.2
Michigan	18.0	20.7	2.7	2.7	83.8	30.6	34.7	8.1
New Jersey	12.9	11.0	1.9	1.9	77.4	26.5	23.9	5.2
New York	15.3	13.1	2.9	1.2	62.4	20.2	22.7	8.6
Pennsylvania	16.0	8.5	2.0	1.5	59.5	21.0	19.5	6.5
West Virginia	12.1	12.1	2.8	1.9	77.6	10.3	26.2	3.7
United States	15.8	15.4	4.3	1.9	79.2	21.8	34.8	7.2

Source: The 1971 Survey of Dental Practice, American Dental Association, 1973, p. 27.

The importance of dental auxiliaries in dental manpower productivity was noted in the 1972 Manpower Report of the President in this statement:

> Recent research shows that a dentist can increase his productivity by 80 per cent if he uses a team of three auxiliaries (instead of merely one assistant), and by 130 per cent if he uses four auxiliaries.[12]

It was found in an extensive evaluation study of trained dental assistants that the addition of one dental assistant in the traditional dental office resulted in a 33 per cent increase in productivity of dental treatment.[13]

While the nation is far from realizing the full potential of using dental auxiliaries to meet the need for dental manpower, Pennsylvania is much below the national pattern even though it is also below the national pattern of population per dentist.

Dentist and Dental Specialist Ratios. Indicators of the dental manpower situation are population to dentist and dental specialist ratios. As shown in Table 12, the United States had in 1970 one dentist for every 1,697 people, while Pennsylvania had one dentist for every 1,750 people and a rank 7 among 14 comparable states. To have a dentist to population ratio in Pennsylvania equal to the national ratio would require additional dentists to serve a total of 357,167 people. Using the national mean patient average (Table 8) per dentist of 1,485, one

[12] Manpower Report of the President, U.S Department of Labor, Washington, D.C., March 1972, p. 136.

[13] "A Two-Year Evaluation of Auxiliaries Trained in Expanded Duties," by Louise Brearky and Freeman N. Rosenblum, Journal of the American Dental Association, March 1972, p. 600.

can see an immediate shortage of 241 dentists in Pennsylvania. Using the Middle East Region, which includes Pennsylvania, where the per dentist patient average is 1,388, the dentist shortage becomes 257, or 3.8 per cent, disregarding future population or growth. The national ratio of dental specialists to population is one specialist for 19,862 people. In Pennsylvania the ratio in 1970 was one specialist for 26,683 people with a rank of 12 among 14 comparable states. To bring the dental specialist ratio in Pennsylvania up to the national average would require 157 additional dental specialists, and for the population increase to 1980, an additional 18 or a total of 175, 1970-80, about a 38 per cent increase. Table 12 presents relevant data.

Table 12

Dentist and Dental Specialist to Population Ratios for Selected Large Urban States Contiguous to Pennsylvania, 1970

States	1970 Population[1]	Number Dentists[2]	Population Per Dentist	Rank	No. Specialists[2]	Population Per Specialist	Rank
New York	18,237,000	14,925	1,222	1	1,107	16,474	4
Massachusetts	5,689,000	4,094	1,390	2	380	14,971	3
California	19,953,000	13,489	1,479	3	1,586	12,581	1
Connecticut	3,032,000	2,032	1,492	4	206	14,718	2
New Jersey	7,168,000	4,554	1,574	5	414	17,314	5
Illinois	11,114,000	6,395	1,738	6	523	21,250	8
Pennsylvania	11,793,909	6,739	1,750	7	442	26,683	12
Michigan	8,875,000	4,734	1,875	8	499	17,786	6
Ohio	10,652,000	5,240	2,033	9	401	26,564	11
Maryland	3,922,000	1,888	2,077	10	190	20,642	7
Indiana	5,194,000	2,321	2,238	11	210	24,733	10
Delaware	548,000	240	2,283	12	25	21,920	9
Texas	11,197,000	4,700	2,382	13	380	29,466	14
West Virginia	1,744,000	640	2,520	14	61	28,590	13
United States	204,879,000	120,739	1,697		10,315	19,862	

[1]Statistical Abstract of the United States, 1971, p. 12ff.

[2]Facts About States, American Dental Association, Chicago, Illinois, 1971, pp. 6-7.

Declining Dental Manpower in Commonwealth

Looking at the change in population and the change in number of dentists, 1960-70, one can further increase his understanding of the dental manpower problem. In this period the number of dentists increased in the nation 14.8 per cent while the population increased 13.3 per cent, a 1.5 per cent improvement in the relationship of dentists and total population. But in Pennsylvania the number of dentists decreased by 4.6

per cent while the population increased by 4.2 per cent, a negative effect on the dentist to population relationship of 8.8 per cent. Yet some states had a great improvement in this relationship, such as Maryland, 44.5 per cent; Texas, 20.6 per cent and Delaware, 13.6 per cent. (Table in Appendix D gives more data.)

While dentists have doubtlessly increased their efficiency, as previously indicated, such increased efficiency applies relatively to the nation and Pennsylvania. Nevertheless, when one looks at population and dentist changes in ratios, 1960-70, one notes what amounts to an increase in the load of Pennsylvania dentists, as compared to all dentists, of 12.1 per cent. Table 13 provides the indication of decreasing efficiency in meeting dental care needs.

Table 13

Decreasing Efficiency in Population to Dentist Ratio in Pennsylvania, 1960-1970

Year	U.S. Population[1]	U.S. Dentists[2]	U.S. Pop. Per Dentist	Pa. Population[3]	Pa. Dentists[4]	Pa. Pop. Per Dentist	Difference	Per Cent Increase Load on Pa. Dentists
1960	180,671,000	105,140	1,718	11,319,366	7,063	1,603	115	
1970	204,879,000	120,739	1,697	11,793,909	6,739	1,750	-53	12.1[5]

[1] Statistical Abstract of the United States, 1972, U.S. Department of Commerce, Washington, D.C., p. 5. (Includes population in Armed Forces.)

[2] Ibid., p. 70.

[3] Pennsylvania Abstract, 1972, Department of Commerce, Harrisburg, Pa., p. 10.

[4] Distribution of Dentists in the United States by State, Region, District and County, American Dental Association, Chicago, Illinois, 1961 and 1971, p. 46.

[5] Assuming the average number of patients cared for by a Pennsylvania dentist is 1,388 annually (American Dental Association Survey of Dental Practice 1971, p. 34), the potential increased load per dentist in 1970 was (168/1,388) 12.1 per cent.

How Many Dentists in Pennsylvania?

Table 14, column (1) indicates the number of dentists determined from American Dental Association Directories. Column (2) shows the U.S. census count of dentists for 1960 and 1970, which is lower than the American Dental Association count by 1,135 and 1,185, respectively. The census count is likely to be an underestimate for a profession, for it is based on a sample in which the total number of dentists may be only .0047 per cent. Nevertheless, both the ADA count and the census count show the same relative decline in the number of dentists in Pennsylvania.

Table 14

Number of Dentists in Pennsylvania,
According to Data Sources, 1960-71

Year	Practicing Dentists ADA Directories[1]	U.S. Census Dentists[3]	Pa. Licensed Dentists[4]	Newly Licensed Dentists[5]	Cumulative Total[6]
	(1)	(2)	(3)	(4)	(5)
1960	7,063	5,873			
1961	7,008		8,490	272	7,335
1962	7,001			285	7,620
1963	6,925		8,607	275	7,895
1964	6,778			251	8,146
1965	6,739		8,612	249	8,395
1966	6,738			255	8,650
1967	6,759[2]		8,668	296	8,946
1968	6,780			308	9,354
1969	6,806		8,686	193	9,547
1970	6,739	5,554		206	9,753
1971	6,722		8,717	258	10,011

[1]Number of Pennsylvania dentists from American Dental Association directories, as provided by the Bureau of Economic Research and Statistics, January 22, 1973.

[2]Number for 1967 is estimated from 1966 and 1968.

[3]U.S. Census underestimated directories by 1,190 in 1960 and 1,185 in 1970.

[4]Data on licensed dentists was supplied by the Secretary of the Pennsylvania Dental Council and Examining Board, 1972.

[5]Newly licensed annual input of dentists.

[6]Except for withdrawal of dentists, the number of dentists would have been 10,011 in 1971, with addition of annual input in column (4) to 1960 total of 7,063.

Column (3) shows the number of dentists licensed to practice in Pennsylvania, a number higher for each year than the count of practicing dentists given by the American Dental Association directories. But, it was found in the National Institutes of Health, Division of Dental Health, dental manpower study[14] that in 1966 dentists holding a Pennsylvania license and residing in other states or in the Armed Forces totalled 1,571 or 22.6 per cent, which may largely account for the discrepancy in the number of licensed dentists as compared with the number of

[14]Compilation State Dentist Manpower Reports, U.S. Department of Health, Education, and Welfare, Bureau of Health Professions, Division of Dental Health, Bethesda, Maryland, 1970, p. 445.

practicing dentists. In fact, when it is assumed that 22.6 per cent of the Pennsylvania licensed dentists reside and practice in another state (8,717 reduced by 22.6 per cent in 1971), the number of practicing dentists becomes 6,747 compared to the 6,722 given by the American Dental Association. The most accurate count of practicing dentists is, therefore, that given by the American Dental Association, and it has been used throughout this study.

Column (4) gives number of newly licensed dentists each year. The lowest number (193) was licensed in 1969 and the largest number (285) in 1961. In 1971, an upward trend began with the licensing of 258 new dentists.

Column (5), Table 14, indicates that the total number of dentists in Pennsylvania, 1961-71, could have reached 10,011 in 1971, disregarding all withdrawals (death, retirement, disability, migration).

Distribution of Dentists in Pennsylvania

Unsatisfactory as is the population per dentist (1,750) in Pennsylvania, even more unsatisfactory is the dentist population relationship by counties and by the 10 state planning regions. Of the 67 counties, 45 have above 2,000 people per dentist and 56 above the state average of 1,750. Twelve counties have population per dentist of 3,140 to 16,712.

Three counties have only one dentist each: Juniata, 16,712 population; Forest, 4,926 and Sullivan, 5,961, representing the most notable examples of a deficiency in dental manpower in the Commonwealth.

Philadelphia County and Allegheny County had a total of 2,486 dentists, or 36.8 per cent of the total number in 1970, with population per dentist of 1,447 and 1,409, respectively.

Of the 10 state planning regions, the most desirable population to dentist ratios were, in order, Region 1, 1,505; Region 3, 1,768; Region 8, 1,784; Region 2, 1,873; Region 10, 1,915; Region 4, 1,990; Region 6, 2,073; Region 7, 2,349; Region 9, 2,408 and Region 5, 2,432. (See Appendix E.) With the median for the 10 regions at 1,953 people per dentist, the population per dentist ratio is 24.59 per cent greater in Region 5; 23.3 per cent greater in Region 9 and 21.0 per cent greater in Region 7.

Taking the mean patient load per year for dentists in the Middle East Region, which includes Pennsylvania, as the norm, 1,388 patients in 1970 (Table 8), it is clear that many people are not getting dental care and that more dental manpower would be required to improve service.

Besides population to dentist ratios as indicators of dental care demand, the remoteness of people from the dentist in terms of area or distance may contribute to the dental care problem. This is seen both in examination of Figure 1 and Appendix F, the latter indicating

the square miles per dentist by county. Ranked according to ratios less favorable to dental care, population per dentist and square miles per dentist by county, Sullivan County, for example, has square miles per dentist of 478 (rank of 61) and 5,961 population per dentist (rank of 65). Giving the square miles per dentist with rank order and the rank order for population per dentist, one notes the following: Forest, 419 (60) and (64); Juniata, 386 (59) and (67); Potter, 218 (58) and (57); Fulton, 145 (57) and (61); Perry, 138 (56) and (66); Cameron, 135 (54.5) and (38); Pike, 135 (54.5) and (55); Tioga, 104 (53) and (62). For the 67 counties there is rank order correlation between square miles per dentist and population per dentist of 4 = .738.

Figure 1 graphically indicates the number of dentists in parentheses and the population per dentist by counties as of 1970. It also gives an idea of the geographical area served by dentists.

Clearly, as the dental care system now operates, large rural areas are not attractive to dentists because of the likelihood of having fewer patients than in urban areas, hence less income. In addition, remoteness from the dentist appears to be an efficient cause of rural people not seeking dental care, together with their low family income (Appendix A).

Per Capita Buying Income and Distribution of Dentists in Pennsylvania

Economic variables, such as per capita buying income, defined as income minus all taxes, may be efficient causes in the distribution of dentists by counties and planning regions. An examination of Table 15 indicates that per capita buying income and population per dentist ratios are related in the 10 State Board of Education planning regions.

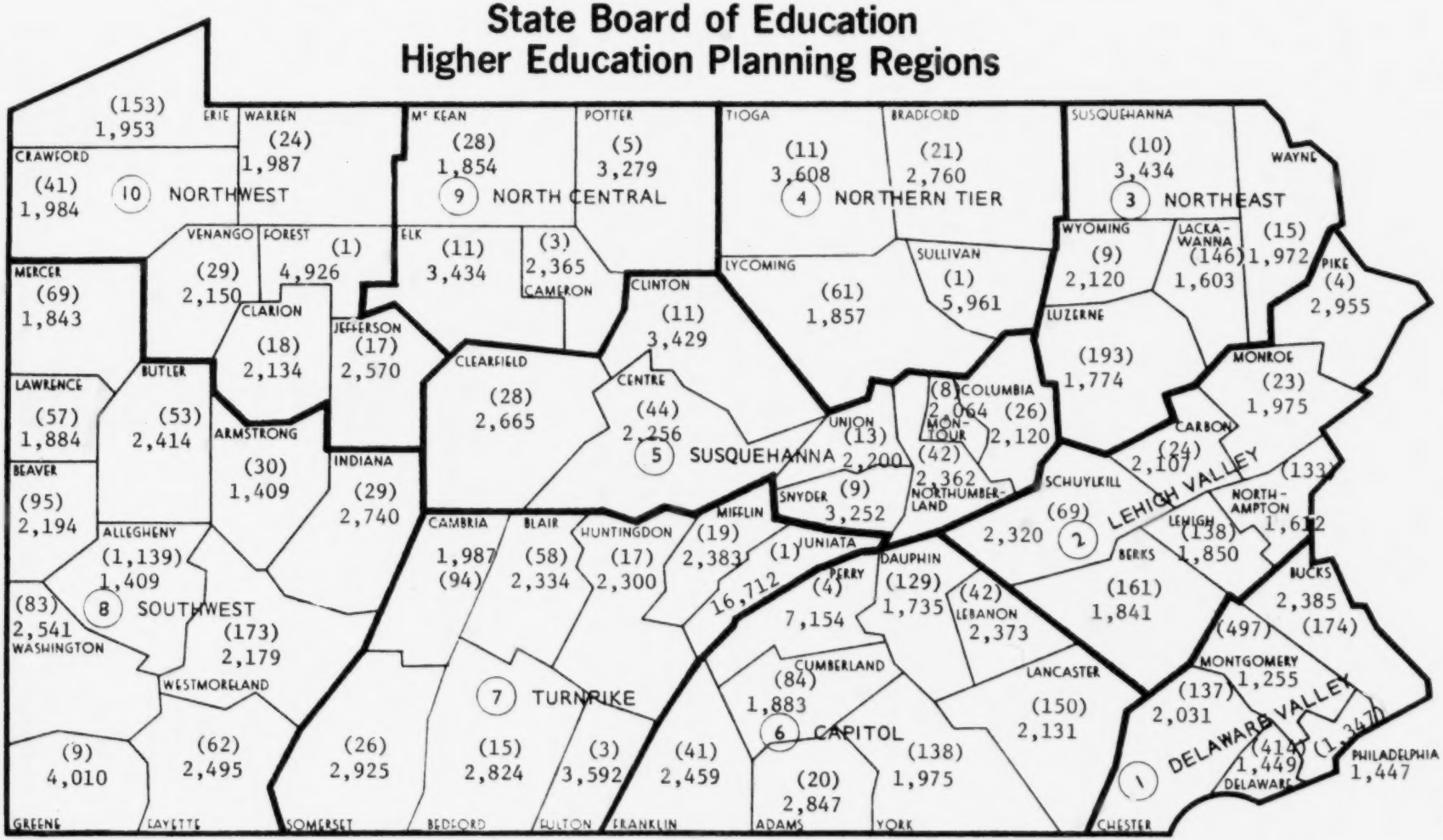
Table 15

Rank Order Relationship of Population Per Dentist and Per Capita Buying Income in the 10 Planning Regions of Pennsylvania, 1970

Region	Population Per Dentist	Rank Order	Per Capita Buying Income	Rank Order
1. Delaware Valley	1,505	1	$3,604	1
2. Lehigh Valley	1,873	4	2,906	3
3. Northeast	1,768	2	2,607	9
4. Northern Tier	1,990	6	2,634	8
5. Susquehanna	2,432	10	2,639	7
6. Capitol	2,073	7	2,936	2
7. Turnpike	2,349	8	2,383	10
8. Southwest	1,784	3	2,687	5
9. North Central	2,408	9	2,889	4
10. Northwest	1,915	5	2,651	6

Figure 1

Population Per Practicing Dentist by Counties in Pennsylvania, 1970,
and Dentists in Each County



The Delaware Valley Region (1) has best population per dentist ratio and also the highest per capita buying income ratio. This relationship is very close, only a one rank difference, to the Lehigh Valley Region (2) and the Northwest Region (10). For the Northern Tier Region (6), the Turnpike Region (7), and the Southwest Region (8), the difference between these variables is only two ranks. In the Northeast Region (3), the two variables are seven ranks apart, showing proportionally a much better ratio of population per dentist than that for per capita buying income. This apparent discrepancy may be due to the fact that dentists were drawn to Luzerne County during the better economic times of the coal industry and have chosen to remain even though income has fallen in the '70s.

The overall thesis that dentists distribute themselves over the various Pennsylvania counties according to the economic variable of per capita buying income is supported in a rank order correlation of population per dentist and per capita buying income. (Appendix G.) The rank order correlation is $r = .84$. This indicates that per capita buying income accounts for 71 per cent of the variation in geographical distribution of dentists in Pennsylvania.

To change the distribution of dentists to reduce the number of people to be served by a dentist apparently requires either increased per capita buying income in a county or region or outside financial support of dental care by government.

Age Distribution of Pennsylvania Dentists and Relationship to Demand for Dental Manpower

An examination of the age distribution of Pennsylvania dentists indicated that the median age in 1970 was 50.3 years compared with a median age of 45.56 for the other states in the Middle East Region and a median age of 45 years for the nation. The median age of Pennsylvania dentists thus exceeded that of other states in the Middle East Region by 4.74 years and that of the nation by 5.3 years. The median age of Pennsylvania dentists is 10.4 per cent greater than that of other states in the Middle East Region and 11.1 per cent greater than that of the nation. Table 16 indicates the age distribution of dentists in 1970.

Assuming that most dentists cease full-time activity at age 70 and that the age distribution has not changed significantly since 1970, one sees a larger than normal retirement group to be replaced. In the 1970-80 period, it is relatively certain that 16 per cent or 1,078 dentists will retire and likely that an additional 13 per cent or 876 dentists will retire. Potential replacement due to retirement then may be 1,954 dentists or an average of 195 per year, 1970-80.

The Pennsylvania dental manpower situation is not only atypical, compared with the nation, in the proportion of dentists approaching or past a retirement age of 70, but it has a more than usual impact on dental care. The number of Pennsylvania dentists having declined by 4.6 per cent, 1960-70, (7,063 to 6,739), and the population in the same period having increased by 4.2 per cent, a negative impact on dental care of 8.8 per cent already exists (Appendix D).

Table 16

Age Distribution of Pennsylvania Dentists, 1970

Age in 1970	Per Cent of Dentists[1]	Number of Dentists	Cumulative Per Cent Distribution	Median
Total	100	6,739		
Under 30	5	337	5	
30-34	10	674	15	
35-39	11	741	26	
40-44	13	876	39	
45-49	10	674	49	
50-54	10	674	59	50.3
55-59	12	809	71	
60-64	13	876	84	
65-69	9	606	93	
70-74	5	337	98	
75 & over	2	135	100	

Source: Compilation of State Dentist Manpower Reports, 1965-67. U.S. Department of Health, Education, and Welfare, Bureau of Health Professions, Education and Manpower Training, Division of Dental Health, Bethesda, Maryland, 1970, p. 448. (Percentage given for 1965 is assumed to be applicable in 1970.)

Demand for Dental Care Related to Fluoridation of Water Supply in Pennsylvania

Another variable capable of impact on the need for dental manpower is fluoridation of water supply. Data given previously (p. 14) showed that such fluoridation accomplished an average reduction of dental caries of children by 65 per cent. The impact of fluoridation in the Commonwealth, past and future, is, therefore, examined here.

In Pennsylvania in 1971 fluoridation of water supply existed in 77 areas and involved 5,226,896 people or 44.3 per cent of the population. Started in 1951, the Pennsylvania fluoridation program served 3,288,382 people by 1955, 4,203,229 people by 1961 and 5,226,896 people by 1971. Table 17 gives the number of areas and the population served 1951-71.

Fluoridation of water supply slowed down in the 1961-71 period: only an additional 8.6 per cent of the population achieved it.

To achieve the national average of 45.5 per cent of the population, fluoridation of water would have to include 141,526 additional people. Using the Middle East average patient load of 1,388 in 1970, one finds that these people require the services of 102 dentists. This

Table 17

Progress of Fluoridation of Water in Pennsylvania, 1951-71

Year	Number of Areas	Population Served	Cumulative Population Served	
1951	3	16,977		
1952	3	729,000		
1953	4	317,727		
1954	6	2,204,678		
1955	0	0	3,288,382	
1956	1	68,820		
1957	4	58,500		
1958	6	606,590		
1959	1	10,000		
1960	3	166,987		
1961	1	3,950	914,847	4,203,229
1962	1	5,125		
1963	5	45,150		
1964	7	69,666		
1965	3	51,868		
1966	4	83,450		
1967	3	62,400		
1968	7	278,808		
1969	1	10,000		
1970	6	177,700		
1971	7	259,500	1,023,667	
Total	77	5,226,896		5,226,896

Source: Data supplied by Harry A. DeWire, Pennsylvania Department of Enrivonmental Resources.

demand for dentists would be greatly reduced if Pennsylvania water fluoridation achieved the national average of 45.5 per cent of the population. It would be further reduced as more and more of the population received the benefit of fluoridation of water.

In terms of patient visits to dentists annually, fluoridation of the Pennsylvania water supply is even more significant. Based on the findings of the National Health Survey that 37.8 per cent of all dental visits are for filling of dental caries,[15] it is possible to estimate the potential impact of fluoridation on Commonwealth dental care.

[15] Dental Visits, United States, July 1963-June 1964, National Center for Health Statistics, Series 10, Number 23, U.S. Department of Health, Education and Welfare, Public Health Service, Washington, D.C., 1965, p. 11.

In the Middle East Region, which includes Pennsylvania, the average number of patient visits per dentist in 1970 was 3,481. The number of dentists in the Commonwealth in 1970, by the American Dental Association count, was 6,739. Total patient visits to dentists in the Commonwealth was, therefore, (3,481 x 6,739) 23,458,459. The total number of these patient visits for fillings was (23,458 x .378) 8,867,297. As indicated previously (p. 14), fluoridation of water can prevent about 65 per cent of dental caries, and on this basis, patient visits to dentists in the Commonwealth for fillings in 1970 could thereby have been reduced by (8,867,297 x .65) 5,763,733 visits. This reduction in dental visits for dental fillings represented the average workload for (5,763,733/3,481) 1,656 dentists in the Commonwealth in 1970. Part of this potential estimated benefit in dental care has been realized by 44.3 per cent of the population, hence the remainder to be realized represents the average workload of (1,656 x .433) 734 dentists.

DEMAND FOR DENTAL MANPOWER IN PENNSYLVANIA

A number of variables effect the demand for dental manpower. They include the desirability of increasing dental services on a population basis at least to the average of the nation, population growth, dental manpower attrition, maintenance of quality dental service and enabling people regardless of income level to have reasonable dental care. These variables, contributing to demand for dental manpower in the Commonwealth, are each herein examined.

Population Per Dentist Lag

By 1980 the population per dentist in the nation is projected to be 1,620 (Table 2), 77 fewer people per dentist than in 1970. For the Commonwealth to reach this national norm, it will have to decrease its rate of people per dentist in 1970 by 130, thus requiring additional dentists to serve 876,070 people. If the present level of dentist productivity continues to service an average of 1,388 people per year, as in the Middle East Region, which includes Pennsylvania, (Table 8), it is estimated that elimination of this dental manpower deficiency would require 631 additional dentists.

Growth in Population 1970-80

The population of the Commonwealth is estimated to increase 1970-80 (12,170,681[16] - 11,793,909) by 362,272. Assuming that a dentist can serve an average of 1,388 people (Table 8), this population growth will require an additional increase in dental manpower of 261 dentists.

Attrition of Dental Manpower

Attrition includes a number of variables that call for continuous replacement of dental manpower, such as retirement, death, disability, out-migration. Data do not exist for full determination of the impact of any of these variables, but some reasonable results can be estimated.

The age distribution of dentists in the Commonwealth (Table 16) indicates that the median age is 10.4 per cent greater than that of other states in the Middle East Region and 11.7 per cent greater than that for the nation. Potential superannuation retirement and death by age 70 would include, 1970-80, 29 per cent of the dentists, a total of 1,954 or 196 per year, representing an average annual retirement-death rate of 2.9 per cent. This rate seems quite reasonable for this age distribution of dentists, for the usual retirement-death expectancy,

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[16] Senier, John K. S. and Philip J. Mulvihill, 1971-1980 Population Projections for Pennsylvania Counties and Major Cities, Pennsylvania Department of Education, Harrisburg, 1972.

average working life of 40 years, has been estimated at 2.5 per cent for the nation.[17]

Dental manpower demand, 1970-80, is estimated, at this point, as 892 dentists for growth and (1,954 + 26) 1,980 for replacement, a total of 2,872, assuming a standard of dental care in the Commonwealth at the projected national level.

Additional Demand Based on Improvement in Dental Care, 1970-80

In a survey of dentists it was reported that only 46.7 per cent of the dentists in the Middle East Region, which includes Pennsylvania, "provided dental care for all who requested appointments, had enough patients, and did not feel overworked,"[18] 23.7 per cent "provided dental care for all who requested appointments, but felt overworked (too rushed or worked, too many hours)," and 13.4 per cent said they were "too busy to treat all people requesting appointments." Strange as it may seem, with 37.1 per cent of the dentists not pleased with their dental care situations, 16.2 per cent of the dentists in the region said they were "not busy enough--would have liked more patients." Relatively, then, discontent with the dental care situation in Pennsylvania by a reported 20.9 per cent (37.1 - 16.2 = 20.9) of the dentists represents a demand for more dental manpower. This condition applies to an estimated 1,408 dentists. There is no way to determine with certainty the additional dental manpower to alleviate the foregoing situation. But, with the average dentist working 46.9 weeks per year, if he or she failed to treat or treated inadequately only two patients per week, he or she would be failing 94 patients per year. For the foregoing 1,408 dentists this would represent 132,352 patients. On the basis of an average workload in the Middle East Region of 1,388 patients (Table 8), this would represent a dental manpower need for 96 dentists.

Besides a significant proportion of the dentists being overworked and turning away people, the national dental health survey in 1969 reported that 13.2 per cent of the people had never gone to a dentist and 14.2 per cent of the people had not been to a dentist in five years (Appendix A). While there are no data on these issues available for Pennsylvania, if one assumes that these percentages apply to the Commonwealth, then there would be 1,556,795 people who never see a dentist and 1,674,735 who see a dentist once in five years. Assuming the continuing development of prepaid dental care and government intervention, 1,122 additional dentists would be required to serve those who never get dental care (1,556,795/1,388 per dentist) and 1,206 dentists to serve on an annual basis those people who now see a dentist once in five years (1,674,735/1,388).

[17] Tomorrow's Manpower Needs, Bulletin No. 1606, U.S. Department of Labor, Bureau of Labor Statistics, Washington, D.C., 1969, p. 47.

[18] The 1971 Survey of Dental Practice, American Dental Association, Chicago, Ill., 1973, p. 39.

Improvement of dental care could, therefore, use additional dental manpower of 2,424 dentists plus 71 for replacements, or 2,495, 1970-80.

Demand for Dental Specialists in Pennsylvania

To provide a dental specialist to population ratio in Pennsylvania comparable with that of the nation (1:19,862) would require 599 dental specialists as of 1970, but the Commonwealth had only 442 (Table 12), indicating a shortage of 157 specialists. Population increase to 1980 of 362,272 would require 18 additional specialists. Total additional dental specialists needed to 1980 then would be 175, or an increase of about 40 per cent. Replacement, using an annual rate of 2.91 per cent, would require 18 specialists, 1970-80, making a total demand of 193 and increasing the total to 635.

Demand for Dental Assistants

In the Commonwealth 59.5 per cent of the dentists as of 1970 had a full-time dental assistant, a total of 4,010 dental assistants. To bring the use of full-time dental assistants up to the national ratio would require an increase of 19.7 per cent (Table 11) or 1,328 dental assistants. For population increase to 1980, an additional 261 dental assistants would be required, for a total of 1,589 full-time dental assistants. This number might involve conversion of some of the 1,415 part-time dental assistants to full-time assistants, but many part-time assistants would still be needed.

As the use of dental assistants and dental hygienists increases, the number of dentists needed would decrease unless the auxiliaries were used principally to increase the quality of service.

Replacement of dental assistants, using a 2.5 per cent rate annually, would require 1,400, 1970-80, making a total demand of 2,989.

Table 18 displays the data on dental auxiliaries:

Table 18

Pennsylvania Dentists Employing Auxiliaries, by Type 1970

Category	Full-Time Practitioners	Per Cent	Part-Time Practitioners	Per Cent
Dentists	6,739	100		
Assistant	4,010	59.5	1,415	21.0
Hygienist	1,078	16.0	573	8.5
Lab. Technicians	136	2.0	101	1.5
Secretary or Receptionist	1,314	19.5	438	6.5
Total Auxiliaries	6,423		2,527	

Source: Percentages are from The 1971 Survey of Dental Practice, American Dental Association, 1973, p. 27.

The Commonwealth is slightly ahead of the national ratio for dental hygienists. As of 1970, with a ratio of 1:10,941 projected population growth to 1980 would require 33 additional dental hygienists. Replacement, assuming 2.5 per cent annually, would require 28 dental hygienists, 1970-80.

To the degree that independent dentists increase the use of dental auxiliaries and dental units, they will increase their income, and when dentists incorporate they will further use dental auxiliaries and increase their income. In 1970, average net income for independent dentists with one chair and no auxiliaries was $16,913, but went as high as $55,245 for the dentist employing five or more full-time auxiliaries.[19]

The mean net income of incorporated dentists rose with the number of chairs and dental auxiliaries and reached $60,000 for five or more chairs and five or more auxiliaries in 1970.[20]

The trend of the pulling power of increased mean net income will undoubtedly cause more and more dentists to incorporate and use more dental auxiliaries, but the impact of this trend on dental manpower cannot be easily quantified.

The percentage of dentists operating with one chair and no auxiliaries was 41.9 per cent in 1952, 20.7 per cent in 1964, 13 per cent in 1967 and 13 per cent in 1970, a dramatic decrease of 28.9 per cent in 18 years, or 1.5 per cent per year.[21] With no reduction from 1967 to 1970, a plateau may have been reached. But should the dentists now having one dental assistant increase this number to three assistants at the 2.3 per cent rate of 1967-70, the demand for full-time dental assistants could increase additionally by (4,010 x 2 x .23) 1,845, 1970-80, with replacement of 46 or a total of 1,891. The range for dental assistant demand is projected, then, as 2,989 to 4,880.

The sine qua non of dental manpower is dentists and dental specialists, but dental auxiliaries can be used to increase the productivity of dentists, hence to increase service or reduce the number of dentists required by the population.

Summary of Dental Manpower Demand in Pennsylvania

The minimum demand for dental manpower in the Commonwealth, 1970-80, is projected to be 2,872 dentists, which includes 892 for growth and 1,980 for replacement.

In this process, the projected need for additional dental specialists is 226. Assuming that the average patient load of specialists

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[19] Ibid., pp. 16-17.

[20] Ibid., p. 18.

[21] Ibid., p. 17 ff.; p. 13 (1968 survey)

is less than that of general practice dentists, an average of 175 patients per year,[22] 29 additional general practice dentists would be needed, increasing the total demand to 2,901. Total demand, 1970-80, represents an increase in the number of dentists of 43 per cent or 4.3 per cent annually.

Optimum demand for dental manpower, making dental care available to all people in the Commonwealth, is projected to require 2,495 additional dentists, increasing total demand to 5,396, 1970-80, or about 80.0 per cent or 8.10 per cent annually.

Economic and attitudinal constraints assure that optimum dental care will not arrive in the Commonwealth, 1970-80, but increasing education and affluence do assure that some of the optimum will be achieved.

The projected average growth rate in dental manpower for the minimum anticipated change is 1.37 per cent annually and the withdrawal rate is 2.94 per cent. Adjustment of the Senier projection,[23] based on the 1970 census and Bureau of Labor Statistics data, to using the American Dental Association data for number of dentists in the Commonwealth, produced an average annual growth rate of 2.11 per cent and a withdrawal rate of 3.14 per cent. These rates are 0.74 per cent higher for growth and 0.20 per cent higher for withdrawals, anticipating achievement of some of the optimum in dental care. Both of these growth rates assume a turnaround in the trend from 1961-71 in which there was an average annual negative rate of -0.38 per cent, contrary to the trend of the nation, in which there was an average annual growth rate of 1.84 per cent, 1960-70.

Projected demand for dental assistants, 1970-80, gives a minimum of 2,989 and an optimum of 4,880, 298 and 480 per year.

Projected demand for dental hygienists, 1970-80, is 313 or 32 per year.

After a presentation of the data on dental manpower supply in Pennsylvania, demand and supply will be interfaced to show estimated need.

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[22] Op. cit., Survey of Dental Practice, p. 35.

[23] Senier, John. Professional Manpower Projections, Unpublished Paper, Paper, February 1, 1973, p. 8.

SUPPLY OF DENTAL MANPOWER IN PENNSYLVANIA

In considering dental manpower supply in Pennsylvania, one should examine it in the context of the national supply, as shown in Table 19, and Table 20. Nationally, dental school enrollment increased by 26.7 per cent in the 1960-71 period and graduates by 16 per cent. In the 1971-80 period, projections indicate that dental school graduates will increase by 18.7 per cent and that dental manpower will increase by 18 per cent, or about two per cent annually. It is quite reasonable to expect dental manpower supply to increase similarly in the Commonwealth and to include an increase for reversing a negative growth situation.

First Year Enrollment in Pennsylvania Dental Schools, Resident and Nonresident

Enrollment in the first-year class at the three Commonwealth dental schools was 342 in 1962 and 431 in 1972, an increase of 89 in annual admissions, 26 per cent, or 2.6 per cent annually. The number of in-state students admitted to the dental schools increased from 161 in 1962 to 245 in 1972, while the proportion changed from 47.1 per cent in 1962 to 56.8 per cent in 1972, an increase of 9.7 per cent. For the 1962-72 period, the three dental schools admitted 49.9 per cent of first-year students from the Commonwealth and 50.1 from out-of-state. Table 19 displays relevant data.

Table 19

First Year Enrollment in Pennsylvania Dental Schools, 1962-72, With In-State and Out-State Percentages

Year	First-Year Dental Students[2]	In-State Students[2]	In-State Per Cent	Out-State Students	Out-State Per Cent
	(1)	(2)	(3)	(4)	(5)
1962	342	161	47.1	181	52.9
1963	363	171	47.1	192	52.9
1964	370	163	44.0	207	66.0
1965	370	149	40.3	221	59.7
1966	383	167	43.6	216	56.4
1967	401	176	43.8	225	56.2
1968	401	214	53.4	187	46.6
1969	403	223	55.3	180	44.7
1970	410	234	58.4	176	41.8
1971	411	238	57.9	173	42.1
1972	431	245	56.8	186	43.2
Total	4,285	2,141	49.9	2,144	50.1
Mean	390	194.6		194.9	

Source: American Dental Association and Survey of Deans of Dental Schools.

Total Dental School Enrollment in Pennsylvania

A survey of the deans of the three dental schools in the Commonwealth provided the researcher both with trend data and projections.

Enrollment of the three dental schools increased from 1,377 in 1960 to 1,614 in 1972, a mean of 1,450 and a mean annual increase of 18.2 students, or 1.32 per cent. The dental school deans' projected enrollment of 1,666 in 1973, increasing to 1,710 in 1980, an average increase of seven students per year, compared with the previous eight-year period, 1965-72, average increase of 22 students per year. It appears that the dental school deans see the approach of a relatively static situation so far as dental manpower is concerned unless there is an intervention of some additional variables, such as great public support for better dental care.

Growth in enrollment of the individual schools, 1960-72, has been 28.2 per cent for the University of Pittsburgh Dental School, 25.4 per cent for the University of Pennsylvania Dental School and 8.7 per cent for Temple University Dental School. For the 1960-80 period, the annual enrollment growth of these schools, including the deans' projections, will be 28.5 per cent for Pennsylvania, 32 per cent for Pitt and 10.6 per cent for Temple.

So far as present plans of the dental schools are concerned, very little growth in enrollment is projected, about 0.8 per cent per year, and access to dental school education will improve very little. Table 20 displays the basic data.

Dental School Graduates in Pennsylvania

The end product of dental school enrollment is graduates qualified to be licensed as dentists by state board examination. The three Commonwealth dental schools produced 351 graduates in 1960 and 383 in 1972, an increase of 32 graduates, 0.7 per cent annually. Dental school deans projected the number of graduates as 392 in 1973 and 433 in 1980, an average annual rate of increase of 1.63 per cent. Table 21 displays the basic data on graduates.

Basic Dental Manpower Supply System

Relating data on total enrollment in Commonwealth dental schools, total applicants, total first year enrollment and total graduates in Table 21, 1962-72, one can see some characteristics of the manpower supply system (see Table 22).

One notices that while total enrollment, 1962-72, has changed at a rather low annual rate, the student demand for dental education, indicated by the increase in applicants, is very significant. From 1962 to 1971 the number of applicants almost doubled, a 98 per cent increase.

Table 20

Total Enrollment of Dental Schools of Pennsylvania, 1960-72, With Projections of Dental School Deans to 1980

Year	Penn	Pitt	Temple	Total
1960	492	379	506	1,377
1961	493	378	513	1,384
1962	491	370	504	1,365
1963	494	367	497	1,358
1964	472	371	493	1,336
1965	480	381	488	1,349
1966	509	393	494	1,396
1967	533	420	492	1,445
1968	554	428	502	1,484
1969	556	455	576	1,587
1970	570	469	530	1,569
1971	578	469	535	1,582
1972	577	486	550	1,614
Projections by Dental School Deans				
1973	604	502	560	1,666
1974	616	510	560	1,686
1975	622	516	560	1,688
1976	632	520	560	1,710
1977	632	520	560	1,710
1978	632	520	560	1,710
1979	632	520	560	1,710
1980	632	520	560	1,710

(Data from Annual Report 1971-72, Dental Education, American Dental Association, Chicago, Ill., p. 20, and dental school deans).

Table 21

Graduates From Pennsylvania Dental Schools, 1960-80

Year	Penn	Pitt	Temple	Total
1960	117	97	137	351
1961	117	92	113	322
1962	124	96	136	356
1963	101	90	126	317
1964	119	95	128	342
1965	116	92	112	320
1966	104	80	114	298
1967	109	80	125	314
1968	121	102	114	337
1969	127	95	103	325
1970	131	98	132	361
1971	137	111	124	372
1972	142	115	126	383
	Projections by Dental Schools			
1973	138	121	133	392
1974	156	121	136	413
1975	147	121	136	404
1976	157	130	140	427
1977	158	130	145	433
1978	158	130	145	433
1979	158	130	145	433
1980	158	130	145	433

(Data from Annual Report 1971-72, Dental Education, American Dental Association, Chicago, Ill., 1972, p. 30, 1960-70; for 1971 and 1972 Survey of Deans of Pennsylvania Dental Schools.)

Table 22

Enrollment, Applicants, First Year Enrollment, Graduates, Application/ Admission Ratio and Class Attrition, Pennsylvania Dental School, 1962-71

Year	Total Enrollment[1]	Total Applicants[2]	First Year Enrollment[3]	Total Graduates[4]	Ratio Col.2/ Col.3	FYE as Per Cent of Applicants	Per Cent Dental School Attrition Year 1 to 4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1962	1,365	1,535	342	353	4.60	22.3	
1963	1,358	1,742	363	322	4.57	20.0	
1964	1,336	2,069	370	335	5.59	17.0	
1965	1,349	2,415	370	309	6.52	15.0	9.64
1966	1,396	2,529	383	315	6.60	15.0	13.22
1967	1,445	2,584	401	310	6.44	15.0	16.21
1968	1,484	2,671	401	331	6.66	15.0	10.54
1969	1,587	2,843	403	305	7.05	14.2	20.36
1970	1,569	2,887	410	372	7.76	14.0	7.23
1971	1,582	3,038	411	398	7.39	13.0	7.73
1972	1,613		431	388			
Mean	1,447	2,431	385	332	6.31	15.8	13.77

[1]Annual Report, 1971-72, Dental Education, American Dental Association, Chicago, Illinois, 1972, p. 21.

[2]Applicants to Dental School 1967, Table 5, 1963-67; Analyses of Applicants to Dental School and First Year Enrollment 1969, Table 2; Ibid., Table 3; Op. cit., Annual, p. 17.

[3]From American Dental Association reports.

[4]Op. cit., Annual Report, 1962-70; Survey of Deans of Pennsylvania Dental Schools.

First year enrollment for the three dental schools in the Commonwealth was 342 in 1962 and increased to 431 in 1972, or 26 per cent. This was a minimal response to the student demand for dental education. In fact, the number of first-year enrollees was a consistently decreasing percentage of the number of applicants, decreasing from 22.3 per cent in 1962 to 13 per cent in 1971. Column (7) shows that the ratio of applicants to first-year enrollees increased from 4.6 to 1 in 1962 to 7.39 to 1 in 1971.

Potential Supply of Dental Manpower

In Table 21 one sees the dental manpower system as it now operates in Pennsylvania projected to 1980, using projections of dental school deans. In Table 23 one sees more details of the present system and projections based on the number of potential dental students, disregarding the constraint of available space in the dental schools.

In Table 23, column (3), the percentage of male bachelor's degree recipients entering dental school is given, 1962-72, and the average rate of 1.61 per cent is used to project the number of first-year dental students at the three Pennsylvania dental schools that could enter each year, 545 in 1973 to 724 in 1980.

In column (5) one sees the average percentage of first-year students who graduated, 1966-72, 90.76 per cent. Applying this rate to the projected number of first-year students provides the projection of potential dental graduates, column (4), as changing from 495 in 1973 to 657 in 1980.

Column (6) provides the average percentage of Pennsylvania dental school graduates who were licensed as dentists, 1966-72, 79.64 per cent. Applying this percentage to graduates (column 4), produces the projections of the potential supply of licensed dentists (column 6), as changing from 385 in 1972 to 523 in 1980, an annual rate of 4.48 per cent.

By the projections of the dental school deans the production of graduates, 1973-80, will be a total of 3,368 (Table 21). By projections of student demand, 1973-80 (Table 23), the total production of graduates of Pennsylvania dental schools will be 3,629. Production of dental school graduates could thus be potentially 7.75 per cent greater if the schools were able to respond fully to the student demand for dental education.

Migration and Dental Manpower Supply

The Compilation of State Dentist Manpower Reports, 1970, gave data for the Commonwealth as of 1966.[24] It showed 92 per cent of licensed dentists as graduates of Pennsylvania dental schools. Of the eight per cent from 42 out-of-state schools, the University of Maryland supplied two per cent. Only two other schools, Georgetown University and Howard University, supplied as much as one per cent of the dentists.

As given in Table 23, the number of dentists licensed annually represents 79.64 per cent of the graduates of Commonwealth dental schools, but it is assumed that 8 per cent of this number continued to come from out-of-state schools. This indicates that the average supply of graduates from Commonwealth schools licensed as dentists in Pennsylvania is 71.64 per cent. Consequently, 28.36 per cent of graduates of Pennsylvania dental schools went to other states. Migration of dental graduates, therefore, shows a net loss to the Commonwealth of 20.36 per cent. This net migration deficit could be reduced by admission of more Pennsylvania applicants to Commonwealth dental schools.

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[24] The Compilation of State Dentist Manpower Reports, U.S. Department of Health, Education, and Welfare, Bureau of Health Professions, Education and Manpower Training, Division of Dental Health, Bethesda, Maryland, 1970, p. 446.

Table 23

Some Characteristics of the Supply System for Dentists in Pennsylvania, 1962-80

	Male Bachelor's Degrees Conferred Year Y	First-Year Dental Students Year Y	Per Cent Bachelor's as first Year Dental Year Y	Dental Graduates[2] Year Y+4	Graduates as Per Cent of First Year Students Year Y+4	Dentists Licensed in Pa.[3] Year Y+4	Col.6 as Per Cent of Col.4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1962	21,594	342	1.58	298	87.13	255	85.57
1963	22,686	363	1.60	314	86.50	296	94.26
1964	24,500	370	1.51	337	91.08	308	91.39
1965	26,028	370	1.42	325	87.83	193	59.38
1966	18,776	383	2.03	361	94.25	206	57.06
1967	19,949	401	2.01	372	93.02	258	69.35
1968	22,520	401	1.78	383	95.51	385	100.52
1969	26,331	403	1.53				
1970	27,615	410	1.48				
1971	28,505	411	1.35				
1972	31,521	431	1.37				
	Projections						
1973	33,833	545	1.61	495	90.76	394	79.64
1974	34,320	553	1.61	502	90.76	400	79.64
1975	35,658	574	1.61	521	90.76	415	79.64
1976	37,656	606	1.61	550	90.76	438	79.64
1977	39,823	641	1.61	582	90.76	463	79.64
1978	41,561	669	1.61	607	90.76	483	79.64
1979	44,116	710	1.61	644	90.76	513	79.64
1980	45,029	724	1.61	657	90.76	523	79.64

[1]From Degrees Conferred, Our Colleges and Universities Today, Division of Educational Statistics, Pennsylvania Department of Education, annual series, omitting the average number of females, 39.15 per cent. Enrollment projections are from Projections to 1980-81, Division of Educational Statistics, 1971, p. 14, reduced for females by 39.15 per cent.

[2]Annual Report, 1971-72, Dental Education, American Dental Association, Chicago, Illinois, p. 30, and Survey of Pennsylvania Dental School Deans.

[3]Pennsylvania State Dental Council and Examining Board, July 19, 1972.

[4]These estimates are based on the 1965-71 mean percentage of Pennsylvania Dental School graduates licensed in Pennsylvania, and will be high if the declining trend of 1970 and 1971 continues, but low if rising trend of 1972 takes over.

When the net migration loss of Pennsylvania dental school graduates, 20.36 per cent, is related to the average number of dentists, 1967-72, (disregarding the unknown number of dentist transfers per year to other states) one finds that the loss of graduates represents a net annual rate of .00913 or 0.913 per cent, about one per cent of the average number of practicing dentists.

Residency and Dental Manpower Supply

In a New York State study of dental manpower, nonfederal dentists who graduated in 1950, 1955 and 1960-65 were surveyed regarding residency and place of practice. It was found that (1) New York residents who attended New York dental school went into practice in New York State at the rate of 84.5 per cent, (2) that New York residents who attended out-of-state dental schools returned to practice in New York State at the rate of 71.4 per cent and (3) that nonresidents who attended New York dental schools began practice in New York State at the rate of 12.6 per cent.[25]

This study clearly indicates the greater likelihood of a state increasing its dental manpower by admitting more of its residents to its dental schools. In fact, the combination of New York residency and attendance at a New York dental school increased the production of New York dentists by 13.1 per cent as compared with residents who went to out-of-state dental schools.

Projections of Dental Manpower Supply

Table 21 gives the projection of graduates by the deans of the Commonwealth dental schools, a total of 3,368, 1973-80, with a mean annual number of 421. This projection shows that the dental school deans expect an increase in graduates of 658, 1973-80, or 82 per cent over the prior eight years, 1965-72.

As shown in Table 24, the number of licensed dentists obtainable from the foregoing output of graduates by Commonwealth dental schools is dependent upon a number of possible entry rates into dentistry. If the system operates as in the past, 71.64 per cent of resident graduates will enter dentistry. On that basis, the graduate output would produce 2,412 licensed dentists, 1973-80, or 302 per year (Table 24, column 4).

If the Commonwealth dental schools admit 13.1 per cent more residents to the first-year class, assuming attrition would be the same for residents and nonresidents, the licensed dentist entry rate could be 84.74 per cent of graduates, producing 2,854 licensed dentists, 1973-80, or 357 per year.

Assuming the continued licensing of 8 per cent of the dentists from out-of-state schools, the total licensed without admitting more residents would be 2,681 or 335 per year (Table 24, column 6). With

[25]Wechsler, Henry. New York State Dental Manpower Study, State Department of Education, Albany, N.Y., 1971, p. 53.

admission of 13.1 per cent more residents, the total licensed dentists would become 3,098 or 387 per year, Table 24, column 7.

Table 24

Dental Manpower Supply, 1973-80, Based on Projections of Graduates by Dental School Deans

Year	Deans' Projections Graduates[1]	Graduates Prior 8 yrs. 1965-72[2]	Col.(1) - Col.(2)	Resident Licensed Dentists Rate of .7164[3]	Resident Licensed Dentists Rate of .8474[4]	Dentists Licensed Entry Rate .7964	Dentists Licensed Entry Rate .92[6]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1973	392	320	72	281	332	312	361
1974	413	298	115	296	350	328	380
1975	404	314	90	289	342	321	372
1976	427	337	90	306	362	340	393
1977	433	325	108	310	367	345	398
1978	433	361	72	310	367	345	398
1979	433	372	61	310	367	345	398
1980	433	383	50	310	367	345	398
Total	3,368	2,710	658	2,412	2,854	2,681	3,098
Mean	412	339	82	302	357	335	387

[1]Table 20.

[2]These figures include 8 per cent from out-of-state schools.

[3]This is the dental licensure entry rate - the 8 per cent of out-of-state graduates.

[4]This entry rate assumes the past rate of .7164 + .131 increase developed by admitting a larger proportion of Commonwealth applicants.

[5]This licensure entry rate includes 8 per cent of graduates from out-of-state schools.

[6]This licensure entry rate assumes 84.74 per cent from Pennsylvania and 8 per cent from out-of-state schools.

Table 25 displays the data based on Commonwealth student demand for dental education.

Column (1) indicates the maximum attainable number of dental school graduates as 4,558, or 570 per year. If the licensure entry rate, based on trend of residents being licensed, 71.64 per cent, is used, total licensees would be 3,265, 1973-80, 408 per year. Admitting 13.1 per cent more residents to dental school could produce 3,860, 1973-80, or 483 per year. If those licensed from out-of-state schools continued at 8 per cent, then the totals would be 3,629 and 4,191, respectively, or 454 and 524 per year.

Table 25

Dental Manpower Supply, 1973-80, Based on Projections of Potential Student Demand

Year	Graduates Student Demand Trend[1]	Graduates Prior 8 yrs. 1965-72[2]	Col.(1) - Col.(2)	Resident Licensed Dentists Rate .7164[3]	Resident Licensed Dentists Rate .8474[4]	Dentists Licensed Rate .7964[5]	Dentists Licensed Entry .92[6]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1973	495	320	175	355	419	394	455
1974	502	298	204	360	425	400	462
1975	521	314	207	373	441	415	479
1976	550	337	213	394	466	438	506
1977	582	325	257	417	493	463	535
1978	607	361	246	435	514	483	558
1979	644	372	272	461	546	513	592
1980	657	383	274	470	556	523	604
Total	4,558	2,710	1,848	3,265	3,860	3,629	4,191
Mean	570	339	231	408	483	454	525

[1]From Table 22, column (4).

[2]From Table 20.

[3]Trend rate for resident graduates.

[4]Resident rate for licensure + 13.1 per cent for increased admission of Pennsylvania applicants.

[5]Resident rate of entry + 8 per cent graduates from out-of-state schools.

[6]This entry rate assumes 84.74 from the Commonwealth and 8 per cent from out-of-state schools.

These projections based on student demand for dental education are, of course, not realizable within the projections of the dental school deans. Increase in dental manpower can come from two sources within the admissions, enrollment and graduate parameters envisioned by the deans: (1) increased admission of Pennsylvania resident students and (2) decreased attrition of students during the dental education program.

Admitting More Pennsylvanians to Dental Schools

In the 1962-72 period, 50.1 per cent of first year admissions at the three Commonwealth dental schools went to nonresident students. During 1971 and 1972 the number of nonresident first year admissions decreased to an average of 42.6 per cent, increasing resident admissions to 57.4 per cent. During the 1962-72 period, the admissions of first-year nonresidents at the three dental schools were 18.1 per cent, 44.9 per cent and 80.1 per cent. The average for 1971 and 1972 was 8.9 per cent, 38.3 per cent and 75.8 per cent, representing improvements in favor of Commonwealth students of 9.2 per cent, 6.6 per cent and 4.3

per cent. In subsequent projections, it is assumed that graduates are in the same proportions as admissions.

During 1971 and 1972 dentists licensed in the Commonwealth averaged 84.93 per cent of graduates of Pennsylvania dental schools. Assuming that this percentage includes the past trend of 8 per cent from out-of-state schools, the proportion from Commonwealth schools would be 76.93 per cent. As shown in Table 26, column (5), this projection indicates a supply of 2,691 licensed dentists from Commonwealth dental schools, 1973-80. Since the minimum projected demand is given as 2,901 (p. 31), the projected supply of 2,691, Table 26, column (5), there is a projected need of 210 dentists, 1973-80. Table 26 provides relevant data.

Table 26

Projections of First Year Enrollment, Graduates, Residents and Nonresidents, and Dentists Licensees, 1973-80

Year	Projections FYE[1]	Deans' Projections Graduates	Resident Graduates[2]	Nonresident Graduates[3]	Dentist Licensees Pa. Schools[4]	Dentist Licensees Out-of-State Schools[5]
	(1)	(2)	(3)	(4)	(5)	(6)
1973	421	392	225	167	312	25
1974	444	413	237	176	329	26
1975	434	404	232	172	322	28
1976	459	437	245	182	348	28
1977	465	433	249	184	345	28
1978	465	433	249	184	345	28
1979	465	433	249	184	345	28
1980	465	433	249	184	345	28
Total	3,618	3,368	1,935	1,433	2,691	219

[1]Assume application of average attrition rate of 1971 and 1972, 7.48 per cent, then FYE will be that percentage greater than the number of graduates.

[2]Using average of 1971 and 1972 (Table 19), 57.4 per cent and assuming that all may enter practice in Pennsylvania.

[3]This assumes nonresident graduates as the average of 1971 and 1972, 42.6 per cent.

[4]Based on trend of licensing experience, 1966-72, equal to 79.64 per cent of graduates.

[5]Graduates from out-of-state schools are assumed still to be 8 per cent of licensees, as reported in 1966.

It is clear, however, that the supply of 2,691 dentists could not be obtained from 1,935 resident graduates. Assuming that all 1,935 resident graduates become licensed dentists in the Commonwealth, one notes that there still would be a shortage of (2,691 - 1,935) 756 that would have to come from the nonresident graduates, or 52.82 per cent of that

group. Thus, the foregoing projections of the present system would utilize 756 nonresident graduates and 219 graduates from out-of-state dental schools to meet the minimum demand for 2,901 dentists, 1973-80, leaving the supply system 210 dentists short of the demand.

For the Commonwealth dental school system to meet this shortage of 210 dentists, 1973-80, without increasing facilities, it would be necessary to increase the proportion of Pennsylvanians in the schools. Assuming a retention rate of 84 per cent for resident graduates equal to that reported in the New York study previously cited, resident graduates required to convert 2,691 (Table 26) to 2,901 licensed dentists would require retention of 2,145 resident graduates (1,935 + 210). To retain enough resident graduates to provide for a 16 per cent loss would require 2,553 resident graduates. This would require changing the proportion of resident graduates to 75.86 per cent, leaving nonresidents at 815, or 24.14 per cent. The supply of 2,691 + 210 (Table 26) would then equal the minimum demand of 2,901, this supply still including an estimated 219 dentists from out-of-state schools.

Supply for Optimum Dental Manpower Demand

As previously shown, optimum dental manpower demand, envisioning adequate dental care for the whole population of the Commonwealth, would require 2,424 additional dentists for increase in care and 71 dentists for replacement, or 2,495 dentists, 1973-80. But the modifications required in the system, such as prepaid dental care plans, government provision for more dental care and regional centers, to actualize the innate demand for dental care will be a gradual process. Estimating the achievable portion of the optimum as 10 per cent, the additional demand for dentists would be for 250 dentists, 1973-80.

Without expansion of dental schools, the 250 additional licensed dentists could be achieved by increasing the proportion of resident graduates from Commonwealth dental schools to 84.64 per cent.

Additional Input of Deans of Commonwealth Dental Schools

Evaluation of the foregoing presentation of dental manpower demand, supply and need should be made in terms of the informed opinions of the leaders in the production of dental manpower, the deans of the Commonwealth dental schools (see Table 27).

While the deans of the Commonwealth dental schools see the need for more dentists in about the same perspective as the law school deans see the need for lawyers, they do perceive that the need for dental services will be "greatly increased by prepaid dental plans" and "by increasing governmental support of dental services."

The deans also indicated that Commonwealth dental schools are responding to the recommendation of the Carnegie Commission on Higher Education to reduce time for dental education from four to three years. Temple University Dental School inaugurated the three year program in 1969 prior to the Carnegie Commission report.

Table 27

Survey of Deans of Dental Schools in Pennsylvania, 1972

August 1972 deans of Pennsylvania dental schools supplied information on dental education. Data from the first three parts, dealing with first year enrollment, graduates and total enrollment, appear in various tables in this report. The remainder of the information is summarized here.

1. Is expansion of facilities being planned or underway?

Penn	Pitt	Temple
Yes	No	No

2. If so, how many additional students to be accommodated?

Penn	Pitt	Temple
10	0	0

3. What percentage of graduates go into dentistry?

Penn	Pitt	Temple
100%	100%	100%

4. Is there a need for more dentists in Pennsylvania now?

Penn	Pitt	Temple
Yes	Principally Maldistribution	No

5. Will the need for dental services be greatly increased by

   a. Prepaid dental plans, such as Blue Cross?

Penn	Pitt	Temple
Yes	Yes	Yes

   b. Increasing governmental support for dental services?

Penn	Pitt	Temple
Yes	Yes	Yes

6. Planning to adopt Carnegie Commission on Higher Education recommendation to reduce time for dental education degree from four to three years?

   Penn--Studying it. Have multi-track system now--students can graduate in three years by advanced placement and an accelerated program.

   Pitt--Enrichment program emphasized now but student can graduate in three calendar years.

   Temple--Started three-year program four years ago. "As many as 50 per cent of the new seniors will graduate in December 1972."

Effect on Dental Manpower by Changing from Four-Year to Three-Year Dental Education Program

If the three Commonwealth dental schools changed to only one program, a three-year one, as recommended by the Carnegie Commission on Higher Education,[26] they could increase their dental manpower output and reduce per student cost both to the schools and the students.

Quite clearly, the schools would produce a class of graduates in one-third less time. The 1,616 student spaces used in 1972 by four classes could gradually be utilized by three classes, thus increasing the size of each class and the number of first year admissions. Phasing out the four-year program and phasing in the three-year program could not be fully accomplished in less than three years. At that time the total of each of the three classes could be 539, 539 and 538. The schools would then be admitting a total of 539 instead of 431 as in 1972, or 108 more students per year, an increase of 25.1 per cent. They would be graduating about 496 students compared with 397 in 1972 and by 1984 they could graduate a total of 4,960 students compared with 3,573 in the four-year programs, providing a possible 3,815 licensed dentists.

Supply of Dental Assistants

Dental assistants are prepared in the Commonwealth by the University of Pittsburgh, two community colleges and in vocational-technical schools in secondary, postsecondary and adult programs. The supply of dental assistants is shown in Table 28.

Table 28

Dental Assistant Supply from Pennsylvania Institutions, 1967-72

Institution	Year						Average
	1967	1968	1969	1970	1971	1972	
Temple University							
U. Pennsylvania							
U. Pittsburgh	85	49	55	56	86	57	66
Lehigh Community College		12	18	17	20	21	18
Beaver Community College					4	20	12
Vo-Tech Schools							
Secondary					127	127	127
Postsecondary					22	22	22
Adult					8	8	8
Total	85	61	73	73	267	254	253

Source: Degrees and Other Formal Awards Conferred by Pennsylvania Institutions of Higher Education, Series, Pennsylvania Department of Education, Division of Educational Statistics and VEMIS Surveys by Bureau of Vocational, Technical and Continuing Education. (Vo-tech schools, 1971 data were repeated for 1972 because of lack of 1972 data.)

[26] Higher Education and the Nation's Health, The Carnegie Commission on Higher Education, McGraw-Hill Book Company, New York, October 1970, p. 49.

The average annual supply of dental assistants is 253 per year. With a minimum demand of 298 per year, 1970-80, the estimated annual minimum need is 35 additional dental assistants from preparing institutions. This need, on an optimum basis, is estimated to approach 501 annually, increasing unmet need to 248.

As indicated under dental manpower demand, dental assistants can increase the productivity of the dentist both qualitatively and quantitatively and hence reduce the demand for additional dentists, or increase the quality of care, or both.

Supply of Dental Hygienists

Dental hygienists are prepared by Temple University, University of Pennsylvania, University of Pittsburgh, Northampton Community College and vocational-technical schools in both secondary and postsecondary programs.

Table 29 displays data on supply of dental hygienists.

Table 29

Dental Hygienist Supply from Pennsylvania Institutions, 1967-72

Institution	Year						Average
	1967	1968	1969	1970	1971	1972	
Temple University	102	45	60	58	56	57	63
U. Pennsylvania	31	42	39	31	35	39	36
U. Pittsburgh	53	27	45	42	75	53	49
Northampton Community College							
Vo-Tech Schools					14	13	14
Postsecondary					14	14	14
Total	186	114	144	131	194	176	176

Source: Degrees and Other Formal Awards Conferred by Pennsylvania Institutions of Higher Education, Series, Pennsylvania Department of Education, Division of Educational Statistics and Student Follow-up Survey by the Bureau of Vocational, Technical and Continuing Education.

As indicated (p. 29) only 16 per cent of Pennsylvania dentists in 1970 employed a dental hygienist, and the projected demand, 1970-80, is only 303 or 33 per year.

Since the annual supply of dental hygienists is 176, the supply exceeds the demand, 1970-80, at the present dentist use rate, by (176 - 35) 141 per year. It appears that many dental hygienists have employment independent of dentists.

Both dental assistants and dental hygienists can ameliorate the demand for dental manpower, and will undoubtedly be hired by more dentists as they become increasingly available.

DENTAL MANPOWER NEED IN PENNSYLVANIA

Improving Dental Manpower Distribution in the Commonwealth

Reference to Figure 1 indicates that distribution of dental manpower in the Commonwealth is a problem that requires attention. Reference to Appendix F further emphasizes not only the dentist to population problem but the dentist to geographical area problem.

If the three Commonwealth dental schools would introduce a policy of enrolling dental students from low dental manpower areas, such as Region 5, Susquehanna; Region 9, North Central; Region 7, Turnpike and Region 6, Capital, they could promote more dentists in these areas. This view is supported by a New York State study indicating that "dental school graduates tend to establish their practice in the same region as their residence prior to enrollment, or in an area with somewhat similar characteristics,....regardless of school attended or year of graduation."[27]

This study examined the current practice location of four groups of New York dental school graduates, 1950, 1955 and 1960-65, with respect to four Office of Planning and Coordination regions: (1) graduates originally from New York City, (2) those from two other highly urbanized regions with high dentist to population ratios, Nassau-Suffolk and Mid-Hudson, (3) those from two areas with intermediate dentist to population ratios, Lake Ontario and Western and (4) those from all other OPC regions. Table 30 displays the findings.

Of the 1,081 dentists in the study practicing in New York City or Nassau-Suffolk or Mid-Hudson regions, 700 (65 per cent) had the same region of practice as their original residency. Those from another region but in or around Metropolitan New York numbered 364 or 34 per cent. Those originally from a more urbanized region numbered 17 or 1 per cent.

Of the 311 dentists practicing in OPC regions other than Metropolitan New York or Nassau-Suffolk or Mid-Hudson, 183 (59 per cent) were from the region in which they practiced, 94 (30.2 per cent) were from another similar area and 34 (11 per cent) were from Metropolitan New York or the Mid-Hudson region.

The study further showed that locating a dental school in a particular region did not tend to bring its graduates to practice in the region. Buffalo dental school graduates, originally from Metropolitan New York, located their practice in Metropolitan New York and the Mid-Hudson region with relatively the same frequency as Metropolitan New

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[27] Op cit., New York State study, p. 56.

Table 30

Practice Location by Residence at Enrollment in Dental School for New York Residents Graduated from New York Dental Schools, 1970[1]

1970 Location	Residence at Enrollment[2]							
	NYC		N-S or M-H		LO or W		(Other N.Y.)	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Same OPC as Residence	604	52.9	96	59.2	114	64.7	69	55.2
Different OPC Region								
NYC, N-S, M-H	324	28.4	40	24.7	9	4.0	8	6.4
LO or W	5	0.4	4	2.5	13	5.8	7	5.6
Other New York	20	1.8	5	3.1	25	11.2	22	17.6
TOTAL New York	953	83.5	145	89.5	161	85.7	106	84.8
TOTAL Out-of-State	188	16.5	17	10.5	32	14.3	19	15.2
TOTAL	1,141	100.0	162	100.0	193	100.0	125	100.0

[1]Included are nonfederal dentists who graduated in 1950, 1955 and 1960-65.

[2]OPC regions at enrollment: New York City (NYC), Nassau-Suffolk (N-S) or Mid-Hudson (M-H), Lake Ontario (LO) or Western (W), or Other New York.

Source: New York State Dental Manpower Study, State Department of Education, Albany, New York, 1971.

Yorkers who attended Columbia and New York universities.

While residency and practice data are not available for Pennsylvania, it is reasonable to assume findings similar to those in New York State. With about 78 per cent of the New York dentists in the same region or a similar region to practice as their original residency, there is a high probability that the Commonwealth could change the dental distribution problem by recruiting students from needy areas and encouraging them to have a career in dentistry.

Recruitment of students from needy dental regions might require preferential entrance requirements, loans for tuition and expenses subject to cancellation after some years of practice in the region, and other inducements. Increasing the supply of dental manpower for deficient areas in Pennsylvania is not then necessarily a matter of more dental schools or more graduates, but rather a matter of appropriate intervention by the Commonwealth to have young people from those areas trained in dentistry.

Women and Dental Manpower Supply

Few women are in the dental profession in Pennsylvania, but about one and one-half per cent of the dentists in the United States are women. Increasing interest in the dental profession by women is indicated by a doubling of the number of female dental students in 1971 over 1970 and a similar doubling in 1972 over 1971.

The experience of other nations shows the appropriateness of dental careers for women. In Russia, Finland, Latvia and Lithuania, 80 per cent of dentists are women. In Greece 50 per cent of the dentists are women. In Norway, Sweden, France and Denmark, 23 to 30 per cent of the dentists are women. All the nations of the Western Hemisphere have a nigher percentage of women dentists than the United States.[28]

With Commonwealth dental schools filled to capacity, admission of more women dental students would mean keeping out more men. This would change the character of dental service, but it would not increase the number of dentists. As indicated previously, the only place to create some leeway for Commonwealth dental students, including women, is in reducing the admission of nonresidents.

Minimum Dental Manpower Need

The basic manpower model provides that demand (growth plus replacement--death, disability, migration) - supply (dental school graduates x rate of entry, plus graduates from out-state dental schools) = need.

[28] Dentistry--A Changing Profession, American Dental Association, Chicago, Illinois, 1971, p. 10.

The projected minimum demand for dental manpower, 1970-80, was found to be 2,901 dentists. The projected dental manpower supply was found to be 2,691 licensed dentists, including 219 graduates from out-of-state schools. The minimum need is, therefore, (2,901 - 2,691) 210 dentists in the 1973-80 period.

Without expansion of Commonwealth dental schools but assuming a continued out-of-state supply of 219, the need for 210 dentists could be met by increasing the percentage of resident graduates from 57.4 to 75.86 per cent.

Optimum Dental Manpower Need

As previously shown, provision of dental care for all is projected to increase dental manpower demand by 2,495 additional dentists, making a maximum unmet need for (2,495 + 210) 2,705 dentists. But lack of resources, economic and social, seem to prohibit the realization of dental care for all in the 1973-80 time frame.

Assuming 10 per cent of optimum demand as achievable (.10 x 2,495), there would be an additional need for 250 dentists. This could also be achieved by increasing resident graduates to 84.64 per cent, approaching the New York State dental schools' proportion of resident graduates, 90 per cent. Increasing the proportion of resident graduates to 84.64 per cent would thus meet the need for dental manpower (210 + 250) or 460 dentists, 1973-80, and at the same time make available 916 spaces for Commonwealth students, 115 annually.

If the residency action resulted in reducing the projected 219 graduates from out-of-state schools, it could also be reconstituted from remaining 517 nonresident spaces utilized in Commonwealth dental schools.

Meeting Need for Dentists by Changing to a Three-Year Curriculum

As previously shown, the productivity of the three dental schools can be increased by utilization of a three-year instead of a four-year curriculum. It is estimated that in the 1973-80 period the production of graduates could be increased to 3,770 instead of 3,368 under the four-year program, an increase of 402 graduates. Assuming the linear projection trend of entry, .7964, including 8 per cent from out-of-state schools, this change could produce (.7964 x 402) 320 licensed dentists. Excluding out-of-state schools, this change could produce (.7164 x 402) 288 licensed dentists. Keeping the same percentage of residents as in recent years, one projects the number of dentists to increase (.5740 x 402) by 232 under the three-year program. The three-year program could thus provide from 232 to 320 dentists toward the projected need for 460 dentists.

Fluoridation and Dental Manpower Need

As indicated in the exposition of dental manpower demand, keeping

dental care and the supply system as in 1970, additional application of fluoridation to water supply in Pennsylvania to reach all people could reduce the need for dental manpower by 743 dentists. This gain in productivity may also be considered as another means of meeting increasing demand for dental care, 1973-80.

Summary

Dental manpower need in Pennsylvania, 1973-80, can be met on the basis of the dental school deans' projections of graduates without expansion of dental school facilities, either separately or in combination, by: (1) enrolling more Pennsylvanians in the dental schools and reducing the percentage of nonresident admissions, (2) changing to a three-year instead of a four-year curriculum in each of the three dental schools, increasing the fluoridation of the water supply and (4) using more dental assistants.

If none of the suggested alternatives are implemented, there is, of course, a projected unmet need for dental manpower, 1973-80, of 460 licensed dentists, or an annual average of 58 dentists.

ADA Dentists 1970	Projection Dentists 1980	Average Annual Growth	Average Annual Withdrawal	Average Annual Demand	Average Annual Supply	Average Annual Unmet Need
Projection of Minimum Demand, 1970-80						
6,739	9,640	92	198	290	269	21
Projection of Ten Per Cent of Optimum Demand, 1970-80						
6,739	9,890	116	199	315	269	46
Projection of Optimum Demand, 1970-80						
6,739	12,135	334	206	540	269	271

FINDINGS

Dental Manpower Nationally

1. In 1970 there were 120,739 dentists in the United States, representing a ratio of 1,697 people per dentist, with about 9 out of 10 in private practice.

2. In 46 states the written examination of the National Board of Dental Examiners is used in the licensure process. Only dental school graduates are licensed.

3. While two-thirds of the dental students have a bachelor's degree, minimum predental education of two years of college may be accepted by 12 dental schools, and three years of college by 52 dental schools.

4. The dental education program requires four years generally, but a few dental schools utilize a three-year program. Temple University, for example, graduated half of the 1972 graduates in three years.

5. The average annual output of dental school graduates, 1960-71, was 3,362, the average attrition rate being 12.3 per cent.

6. The number of dental school graduates is projected to increase from 3,749 in 1970 to 4,450 in 1980.

7. The number of dentists is projected to increase in the United States from 120,739 in 1970 to 142,416.

8. By 1980 the population to dentist ratio is projected to be 1,620.

9. On the basis of the Bureau of Labor Statistics projection of an annual need for 4,900 dentists, the average annual shortage from 1968-80 will be 952 dentists.

10. This projection does not anticipate an improvement in dental care to provide for the estimated one billion cavities per year that go untreated.

Conditions of Dental Service Nationally

1. Waiting time for a dental appointment decreased, 1967-70, but averaged 13 days in 1970. For the Middle East Region, which includes Pennsylvania, waiting time averaged 11.5 days in 1970, but for 19 per cent of dental patients, it averaged three weeks, and for 5 per cent of the patients, 6 weeks or more.

2. The interval between dental visits, 1969, was 2-4 years for 14.2 per cent of the population, 5 years or more for 13.2 per cent of the population, and never been to a dentist, 13.3 per cent, a total of 40.7 per cent lacking good dental care.

3. There is a high correlation between family income and use of good dental care.

4. Cost of dental care increased 362 per cent, 1950-70, while personal income increased 209.1 per cent.

5. Mean gross income of dentists increased in the United States, 1967-70, by 6.3 per cent, but in Pennsylvania, 23 per cent, 3.5 times the national increase.

6. In 1970, the dental income in the United States was--mean gross income, $59,325; mean net income, $30,770 and median net income, $28,100. In Pennsylvania, the comparable figures were--$48,509, $26,901 and $26,100.

7. While per capita buying income (income after taxes) was about the same for the United States and Pennsylvania in 1969, $3,078 and $3,086, neighboring states went as high as $3,579.

8. In the sample of states, Table 7, the rank order correlation between per capita buying income and dentist mean income was r = .80, and when related to dentist to population ratios, Table 12, indicates a causative factor in the loss of dental manpower to adjacent states.

9. Average dental patient load per year increased in the United States, 1967-70, from 1,292 to 1,485, or 193 patients; in the Middle East Region, which includes Pennsylvania, 1,243 to 1,388, or by 145 patients.

10. Average number of patient visits per year to a dentist increased in the United States, 1967 to 1970, from 3,527 to 3,565, or by 38 patient visits. In Pennsylvania, the change was from 3,849 to 3,481 per dentist, a decrease of 368 patient visits, or 9.5 per cent.

11. In terms of average patient load, 1967-70, dentist productivity, somewhat because of new technology, increased in the nation by 5 per cent, but in Pennsylvania by 3.9 per cent.

12. In the nation, 1967-70, the dentist's work week changed from 41.7 to 41.5 hours, a decrease of about 12 minutes; however, his or her time at the dental chair decreased by 2.6 hours per week.

13. The work week of the high income dentist and the lc · income dentist is relatively the same.

14. Prepaid plans of dental care in the nation increased by 5.5 per cent, 1962-70.

15. Fluoridation of water supply reduced dental caries in school children by almost two-thirds.

16. Nationally, 45.5 per cent of the population have the benefit of water fluoridation. In Pennsylvania, the percentage is 44.3.

17. Dental auxiliaries are being used extensively in the nation, e.g., 79.2 of the dentists, 1970, had full-time dental assistants, but in Pennsylvania their use was much below the national average, e.g., only 59.5 per cent had dental assistants.

18. Addition of one dental assistant to the traditional dental office can increase productivity by 33 per cent. With a team of three auxiliaries, the dentist can increase his productivity by 80 per cent and with a team of four, by 130 per cent.

19. Compared to the national population to dentist ratio, Pennsylvania had a deficit in dental manpower of 257 dentists in 1970.

20. In dental specialists, compared to the nation, Pennsylvania had a shortage of 157 in 1970, and population growth to 1980 would require 18.

Dental Manpower Conditions in Pennsylvania

1. In the 1960-70 period, in the nation dental manpower increased 14.8 per cent while population increased 13.3 per cent, an improvement of 1.5 per cent in the relationship; but in Pennsylvania the number of dentists declined by 4.6 per cent while the population increased 4.2 per cent, a negative result of 8.8 per cent.

2. Compared to the nation, dental care in Pennsylvania had a decrease in efficiency in terms of service to the whole population of 12.1 per cent (Table 13).

3. Practicing dentists in Pennsylvania in 1970 were 6,739, according to the American Dental Association records.

4. Although Pennsylvania had 8,717 licensed dentists in 1971, approximately 22 per cent of this number were in the Armed Forces or residing in another state.

5. Distribution of dental manpower is a serious problem with 36.8 per cent of the dentists in Philadelphia County and Allegheny County.

6. Twelve counties have population per dentist of 3,140 to 16,712.

7. State planning regions with the poorest ratio of population per dentist, as of 1970, were: Region 6, 2,073; Region 7, 2,349, Region 9, 2,408 and Region 5, 2,432.

8. With the mean patient load for dentists in the Middle East Region, of which Pennsylvania is a part, at 1,388 patients, as of 1970, and population per dentist in the Commonwealth at 1,750, it appears that 362 people per dentist do not get dental care, about 20 per cent of the population.

9. Another indicator of the lack of dental manpower is the area per dentist in square miles, such as Forest County, 419, compared with .09 for Philadelphia County. Extensive rural areas, with a likelihood of fewer patients for a dentist, hence less income for a dentist, lack adequate dental care.

10. Among the 10 state planning regions, the correlation between favorable ranks of population per dentist and per capita buying income is very high r = .84, indicating that improvement of the economy of a region can produce a concomitant improvement in dental services.

11. In 1970 the median age of Pennsylvania dentists was 50.3 years compared to a national median of 45 years. Replacement caused by potential retirement of dentists is high and could require 1,954 dentists, 1970-80.

12. Since it has been established that fluoridation of water supply can reduce dental caries in children by 65 per cent, it is a potential source of reducing need for dental care.

13. In 1971, in Pennsylvania 44.3 per cent of the population had the benefit of fluoridated water compared with a national rate of 45.5 per cent.

14. Need for dental manpower for the whole population, it is estimated, could be reduced by 734 dentists if fluoridation of water supply were extended to the whole population.

Demand for Dental Manpower in Pennsylvania

1. To achieve the projected level of dental care for the nation in 1980, the Commonwealth will have to eliminate a dental manpower deficiency equal to 631 additional dentists.

2. To provide for an estimated growth in population of 362,272 in the Commonwealth, the projected demand for additional dentists, 1970-80, is 261; and 29 for growth in dental specialists.

3. Dental manpower replacement (withdrawal), 1970-80, is projected to require 1,980 dentists. Minimum growth, 921 dentists and replacement, 1980 dentists, constitute a demand for 2,901 dentists. The projected growth rate is 1.37 per cent and withdrawal rate is 2.94 per cent, for a total of 4.31 per cent.

4. Additional potential demand for improvement of dental care in the Commonwealth will require (96 + 1,122 + 1,206) 2,424 dentists for growth and 71 for replacement, or 2,495, 1970-80.

5. Dental specialists totaled 442 in 1970. With a demand for 635 specialists, including replacement, 193 additional specialists will be needed, 1970-80.

6. As of 1970, 59.5 per cent of the dentists had a full-time dental assistant, for a total of 4,010.

7. To achieve the national ratio of dental assistants and provide for population growth, the demand for dental assistants, 1970-80, is projected as 2,989.

8. Dentists changing from one dental assistant to three, 1970-80, will increase demand to a projected 1,891 dental assistants, giving a range for dental assistant demand of 2,989 to 4,880.

9. With 1,078 dental hygienists as of 1970, population growth and replacement will require 61 to 1980.

10. Average net income for independent dentists with one chair and no auxiliaries was $16,913, but went as high as $55,245 for one dentist employing five or more full-time auxiliaries.

Supply of Dental Manpower in Pennsylvania

1. Dental manpower in the nation is projected to increase at a rate of about two per cent per year, 1971-80.

2. First-year student enrollment in the three Commonwealth dental schools changed from 342 in 1962 to 431 in 1972, an increase of about 2.6 per cent annually, and the proportion of resident students changed from 47.1 per cent in 1962 to 56.8 per cent in 1972.

3. Total enrollment changed from 1,377 in 1960 to 1,614 in 1972, about 1.32 per cent annually, and is projected to rise from 1,666 in 1973 to 1,710 in 1980, an average increase of seven students per year, or about 0.8 per cent increase annually.

4. The three Commonwealth dental schools produced 351 graduates in 1960 and 383 in 1972, an average annual increase of 0.7 per cent, and dental school deans project 392 graduates in 1973 and 433 in 1980, a rate of increase of 1.63 per cent.

5. Applicants for admission to the dental schools increased from 1,535 in 1962 to 3,038 in 1971, a 98 per cent increase.

6. By projections of the dental school deans, the three dental schools will produce 3,368 graduates, 1973-80, but resident students would be available to produce 3,629 graduates (Table 23).

7. Pennsylvania dental school graduates represent 92 per cent of the licensed dentists; eight per cent come from 42 out-of-state schools.

8. Dentists licensed represent 71.64 per cent of the graduates of the Commonwealth dental schools, thus 28.36 per cent of graduates went to other states. The net migration loss averaged 20.36 per cent of graduates of Commonwealth dentai schools.

9. In contrast, a recent study shows that New York State residents who attended a New York State dental school went into practice in that state at the rate of 84.5 per cent.

10. Operating as the dental school deans projected, 1973-80, without changing the proportion of out-of-state graduates, the dental schools could produce 2,412 licensed dentists, or 302 per year, but if the facilities were available to admit Pennsylvania applicants, this number could be 3,860 or 483 per year.

11. Using the average rate of Pennsylvania licensure of dental school graduates, 1966-72, of 76.93 per cent, the projected number of licensed dentists could be 2,691 (Table 26), including 219 from out-of-state schools.

12. By increasing the percentage of resident graduates to 75.86 per cent, providing 2,553 resident graduates, of which the New York State study would predict a 16 per cent loss, and without expansion of Commonwealth dental school facilities, the supply could equal the minimum demand for 2,901 dentists (2,691 + 210), 1973-80.

13. Optimum dental manpower demand based on adequate dental care for all would require 2,495 additional dentists.

14. Recognizing that perhaps 10 per cent of optimum demand would be achievable, 1973-80, 250 additional dentists, this goal could be reached by increasing the percentage of resident graduates to 84.64 per cent.

15. Dental school deans (Table 27) gave their views and indicated they were studying the three-year dental program recommended by the Carnegie Commission on Higher Education, but Temple began such program in 1969 and about 50 per cent of the 1972 graduates came from it.

16. The increased productivity of a three-year dental education program is such that were it phased in for all Commonwealth dental schools, the number of graduates could be increased from 397 in four years to 496 in three years. Comparing the two programs, 1973-80, the three-year program could produce 232 to 320 more dentists.

17. Since dental assistants are important to dental manpower efficiency, it should be noted that the average annual production of 253 dental assistants is 35 short of minimum annual need and 248 short of optimum annual need, 1970-80.

18. At the dentist use rate of 16 per cent, the average annual supply of 176 dental hygienists exceeds the average annual demand for 32 dental hygienists by 142. Dentists are more inclined to use dental assistants rather than dental hygienists.

Dental Manpower Need in Pennsylvania

1. Better distribution of dentists, particularly in state education planning regions 5, 6, 7 and 9, could be achieved by intervention to obtain dental students from such regions, for dental graduates tend to establish a practice in the same region or similar region as that of their residence prior to dental education. A New York State study established this probability at 78 per cent.

2. Women find a career in dentistry to be very satisfactory, but only one-half per cent of the dentists in the United States are women. In Europe, 23 to 30 per cent of the dentists are women.

3. Assuming the continuation of the supply of 219 dental graduates from out-of-state schools, the minimum need for 210 dentists can be met by increasing the percentage of resident graduates to 75.86 per cent, 1973-80.

4. Optimum demand, based on dental care for all, would require 2,495 additional dentists.

5. Assuming that only 10 per cent of optimum demand could be achieved, 1973-80, there would be a need for 250 additional dentists. They could be supplied by increasing resident graduates to 84.64 per cent, and at the same time make available for Pennsylvania students 916 spaces, 115 annually.

6. If out-of-state dental schools discontinued their projected supply of 219 dentists, 1973-80, they could be obtained by further reducing the nonresidents in Commonwealth dental schools.

7. Changing to a three-year instead of a four-year dental school curriculum could produce 232 to 320 additional dentists, 1973-80, and meet more than half of the need for more dental manpower.

8. If water supply were universally fluoridated in the Commonwealth, it conceivably could reduce the manpower need requirements by 743 dentists, 1973-80, thus providing manpower for improved care.

9. Projected dental manpower needs of the Commonwealth, 1973-80, can be met without increasing dental school facilities by utilizing separately and in combination these alternatives: (1) enrolling more Pennsylvanians in Commonwealth dental schools, especially from low dental care regions of the Commonwealth, thus reducing nonresident admissions; (2) all three dental schools changing from a four-year

to a three-year curriculum, (3) increasing the fluoridation of water supply and (4) increasing use of dental auxiliaries, particularly dental assistants.

10. If one or more of these alternatives is utilized, the unmet need for dental manpower, 1973-80, is projected as 460 dentists.

APPENDICES

Appendix A

Table 31

Dental Care of Population, United States, 1969, With Time Interval Since Last Dental Visit by Sex, Age, Color, Income, Education of Head of Family and Geographic Region

Characteristic	Total population	Time Interval Since Last Dental Visit													
		Less than 6 months	%	6-11 months	%	1 year	%	2-4 years	%	5 years or more	%	Never	%	Unknown	%
		Number of persons in thousands and percent distribution													
All persons[1]	197,422	63,426	32.1	25,328	12.8	23,291	11.8	28,040	14.2	26,107	13.2	26,247	13.3	4,984	2.5
Sex															
Male	95,002	29,435	31.0	12,132	12.8	11,439	12.0	13,597	14.3	12,242	12.9	13,537	14.2	2,620	2.8
Female	102,420	33,991	33.2	13,195	12.9	11,853	11.6	14,443	14.1	13,865	13.5	12,710	12.4	2,363	2.3
Age															
Under 5 years	18,052	1,421	7.9	573	3.2	289	1.6	77	0.4	...	...	15,486	85.8	205	1.1
5-14 years	41,153	17,250	41.9	6,952	16.9	5,065	12.3	3,342	8.1	458	1.1	7,377	17.9	710	1.7
15-24 years	32,462	12,592	38.8	5,472	16.9	5,071	15.6	5,185	16.0	1,426	4.4	1,948	6.0	768	2.4
25-44 years	46,355	16,264	35.1	6,672	14.4	7,056	15.2	8,889	19.2	5,577	12.0	735	1.6	1,163	2.5
45-64 years	40,742	12,697	31.2	4,536	11.1	4,474	11.0	7,529	18.5	9,901	24.3	411	1.0	1,194	2.9
65 years & over	18,658	3,201	17.2	1,124	6.0	1,337	7.2	3,018	16.2	8,745	46.9	289	1.5	944	5.1
Color															
White	173,207	59,057	34.1	22,833	13.2	20,351	11.7	24,156	13.9	23,042	13.3	19,718	11.4	4,050	2.3
All other	24,215	4,370	18.0	2,495	10.3	2,940	12.1	3,884	16.0	3,064	12.7	6,529	27.0	934	3.9
Family Income															
Less than $3,000	22,070	3,879	17.6	1,987	9.0	2,029	9.2	3,617	16.4	6,231	28.2	3,638	16.5	689	3.1
$3,000-$4,999	22,239	4,816	21.7	2,278	10.2	2,456	11.0	3,767	16.9	4,248	19.1	4,188	18.8	487	2.2
$5,000-$6,999	32,856	8,375	25.5	3,908	11.9	4,098	12.5	5,273	16.0	4,689	14.3	5,729	17.4	785	2.4
$7,000-$9,999	41,221	13,027	31.6	5,583	13.5	5,197	12.6	6,190	15.0	4,385	10.6	5,959	14.5	880	2.1
$10,000-$14,999	43,206	17,239	39.9	6,588	15.2	5,472	12.7	5,336	12.4	3,507	8.1	4,196	9.7	868	2.0
$15,000 or more	24,834	12,699	51.1	3,863	15.6	2,738	11.0	2,376	9.6	1,303	5.2	1,315	5.3	541	2.2

[1] Includes unknown income and education.

Appendix A
Table 31
(contd.)

Characteristic	Total population	Time Interval Since Last Dental Visit													
		Less than 6 months	%	6-11 months	%	1 year	%	2-4 years	%	5 years or more	%	Never	%	Unknown	%
		Number of persons in thousands and percent distribution													
Education of head of family															
Less than 5 years	10,211	1,367	13.4	773	7.6	898	8.8	1,685	16.5	2,564	25.1	2,507	24.6	417	4.1
5-8 years	39,898	8,124	20.4	3,810	9.5	4,561	11.4	7,126	17.9	9,442	23.7	5,674	14.2	1,160	2.9
9-11 years	36,322	9,697	26.7	4,270	11.8	4,620	12.7	5,974	16.4	5,427	14.9	5,457	15.0	877	2.4
12 years	60,174	21,227	35.3	8,519	14.2	7,652	12.7	8,092	13.4	5,609	9.3	7,716	12.8	1,359	2.3
13 years or more	47,805	22,396	46.8	7,663	16.0	5,201	10.9	4,722	9.9	2,522	5.3	4,445	9.3	856	1.8
Geographic Region															
Northeast	49,071	17,855	36.4	6,563	13.4	5,596	11.4	6,360	13.0	6,087	12.4	5,204	10.6	1,407	2.9
North Central	55,455	18,417	33.2	7,094	12.8	7,112	12.8	7,611	13.7	7,762	14.0	6,266	11.3	1,193	2.2
South	60,315	16,752	27.8	6,947	11.5	6,756	11.2	9,076	15.0	8,580	14.2	10,554	17.5	1,650	2.7
West	32,582	10,403	31.9	4,724	14.5	3,827	11.7	4,993	15.3	3,678	11.3	4,223	13.0	733	2.2

Source: Dental Visits, Volume and Interval Since Last Visit, United States, 1969, Series 10, Number 76, National Center for Health Statistics, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1972, pp. 10-11.

Appendix B

Table 32

Comparative Average Dentistry Costs for Selected States and the U.S., Group Health Dental Insurance and Equitable Life Assurance, 1970

PROCEDURE	California	Florida	Illinois	New York	Texas	Virginia	U.S.Average	Group Health Dental Insurance	Equitable Life Assurance
Examination	$4.75	6.00	5.00	5.25	5.50	5.80	4.80	5.00	5.00*
Complete X-Rays	21.00	20.00	18.00	18.80	21.50	21.00	19.40	15.00	17.00
Cleaning	14.00	11.00	11.00	10.60	12.00	10.00	10.50	7.00	5.00*
Filling--Silver Single Surface	11.50	9.00	8.75	8.00	9.70	7.75	8.60	5.00	5.00
Filling--Silver Two Surface	18.00	14.00	14.00	14.50	15.20	12.50	13.75	10.00	10.00
Filling--Gold Inlay Single Surface	58.00	55.00	41.00	47.00	52.00	45.00	47.00	10.00	29.50
Filling--Gold Inlay Two Surface	74.00	74.00	60.00	72.00	70.00	66.00	66.00	10.00	44.00
Simple Extraction	13.00	11.00	9.60	11.25	10.50	9.10	10.00	6.00	7.50
Root Canal--Single	81.00	80.00	64.00	77.00	85.00	71.00	72.00	50.00	50.00
Root Canal-- Three Root Canals	137.00	135.00	116.00	151.00	145.00	124.00	131.00	75.00	87.50
Full-Cast Gold Crown	100.00	102.00	91.00	115.00	91.00	104.00	100.00	70.00+	54.50
Crown With Porcelain Jacket	120.00	116.00	107.00	131.00	119.00	115.00	117.00	80.00+	73.00
Fixed Bridge-- Two Teeth	240.00	220.00	190.00	250.00	191.00	216.00	208.00	100.00+	X
Fixed Bridge-- Four Teeth	440.00	450.00	380.00	502.00	364.00	430.00	415.00	200.00+	X
Partial Denture With Clasps	180.00	184.00	198.00	201.00	180.00	163.00	176.00	110.00+	100.00
Full Denture	250.00	204.00	220.00	235.00	200.00	190.00	207.00	150.00+	125.00

KEY TO CHART: X Information not available. *Equitable allows $5.00 to cover both examination and cleaning. +G.H.D.I. Allowances on Prosthetics run from 25 per cent to 100 per cent of maximum shown here. SOURCE: American Dental Association with ten per cent added by Esquire, February 1973.

Appendix C

Table 33

Percentage of Nonsalaried Dentists in Various Income Categories, 1967 and 1970

Gross Income	Per Cent 1970	Per Cent 1967	Per Cent Difference	Incorporated Dentists, 1970
$ 1,950-$ 3,949	0.2	0.2	0.0	0.0
3,950- 5,949	0.4	0.3	0.1	0.0
5,950- 7,949	0.3	0.4	-0.1	0.0
7,950- 9,949	0.5	0.6	-0.1	0.6
9,950- 11,949	0.5	0.7	-0.2	0.0
$11,950-$13,949	0.9	1.0	-0.1	0.0
13,950- 15,949	1.2	1.5	-0.3	0.0
15,950- 17,949	0.9	1.0	-0.1	0.0
17,950- 19,949	1.	2.0	-0.9	0.0
19,940- 21,949	1.8	2.1	-0.3	0.6
$21,950-$23,939	1.4	2.6	-1.2	0.6
23,950- 25,949	2.2	3.7	-1.5	0.0
25,950- 27,949	1.4	3.2	-1.8	0.0
27,950- 29,949	2.1	3.5	-1.4	0.0
29,940- 31,949	2.7	4.7	-2.0	0.6
$31,950-$33,949	2.4	3.9	-1.5	0.0
33,950- 35,949	2.8	4.4	-1.6	0.0
35,950- 37,949	2.9	4.2	-1.3	0.0
37,950- 39,949	2.3	3.8	-1.5	0.6
39,950- 41,949	3.2	5.2	-2.0	0.6
$41,950-$43,949	2.6			1.2
43,950- 45,949	3.3			0.0
45,950- 47,949	2.5			1.2
47,950- 49,949	3.1			0.6
49,950- 51,949	4.3	19.2	3.4	1.2
$51,950-$53,949	2.8			0.0
53,950- 55,949	3.0			1.2
55,950- 57,949	1.9			0.6
57,950- 59,949	2.1			0.6
$51,950-$61,949		13.2		
$59,950-$69,949	11.9			4.6
$61,950-$71,949		7.4		
$71,950 and up		10.9		
$69,950-$79,949	8.9			11.1
$79,950-$89,949	7.0			15.7
$89,950-$99,949	5.3			13.4
$99,950 and up	9.8			44.4

Source of Data: 1968 and 1970 Survey of Dental Practice, American Dental Association, Chicago, Illinois, p. 9. (The decreasing percentage of dentists in income categories in 1970 is shown by the minus sign, e.g., -0.3.)

Appendix D

Table 34

Growth in Number of Dentists in Selected States and Relationship to Population Change 1960-1970

	Dentists 1970[1]	Dentists 1960[2]	Growth 1960-70	Per Cent Change No. of Dentists 1960-1970	Per Cent Change in Population 1960-1970	Dentist Difference 1960-1970
	(1)	(2)	(3)	(4)	(5)	(6)
New York	14,925	14,179	746	5.3	8.4	-3.1
Massachusetts	4,094	3,615	479	13.3	2.4	10.9
California	13,489	9,840	3,649	37.0	27.0	10.0
Connecticut	2,032	1,778	254	14.3	12.7	1.6
New Jersey	4,554	3,927	627	16.0	26.5	-10.5
Illinois	6,395	6,413	- 18	-0.3	10.2	-10.5
Pennsylvania	6,739	7,063	-324	-4.6	4.2	- 8.8
Michigan	4,734	4,122	612	14.8	13.4	1.4
Ohio	5,240	4,820	420	8.7	9.7	- 1.0
Maryland	1,888	1,298	590	45.5	- 1.0	46.5
Indiana	2,321	2,204	117	5.3	11.4	- 6.1
Delaware	240	176	64	36.4	22.8	13.6
Texas	4,700	3,418	1,282	37.5	16.9	20.6
West Virginia	640	722	- 82	-11.4	-6.2	5.2
United States	120,739	105,104	15,635	14.8	13.3	1.5

[1]Distribution of Dentists in the United States, American Dental Association, Chicago Illinois, 1971, p. 4.

[2]Op. cit., 1961, p. 4.

Appendix E

Table 35

Change in Number of Dentists in Pennsylvania by Ten Planning Regions and by County, 1960-70

Region	Dentists 1970	Dentists 1960	Differences	Per Cent Change	Pop. Per Dentist 1970
1. Delaware Valley	2,569	2,605	- 36	-01.4	1,505
Bucks	174	105	69	62.8	2,385
Chester	137	96	41	42.7	2,031
Delaware	414	351	63	17.9	1,449
Montgomery	497	371	126	34.0	1,255
Philadelphia	1,347	1,682	-335	-28.7	1,447
2. Lehigh Valley	552	574	- 22	-03.8	1,873
Berks	161	168	- 7	-04.2	1,841
Carbon	24	26	- 2	-07.7	2,108
Lehigh	138	139	- 1	-00.7	1,850
Monroe	23	23	0	00.0	1,975
Northampton	133	136	- 3	-02.2	1,612
Pike	4	4	0	00.0	2,955
Schuylkill	69	78	- 9	-11.5	2,320
3. Northeast	373	415	- 42	-10.1	1,768
Lackawanna	146	149	- 3	-02.0	1,603
Luzerne	193	227	- 34	-15.0	1,774
Wayne	15	14	1	07.1	1,972
Wyoming	9	12	- 3	-25.0	2,120
Susquehanna	10	13	- 3	-23.9	3,608
4. Northern Tier	94	109	- 15	-13.8	1,990
Bradford	21	25	- 4	-16.0	2,760
Lycoming	61	68	- 7	-10.3	1,857
Sullivan	1	1	0	00.0	5,961
Tioga	11	15	- 4	-26.6	3,608
5. Susquehanna	181	191	- 10	-05.2	2,432
Centre	44	35	9	25.7	2,256
Clearfield	28	32	- 4	-12.5	2,665
Clinton	11	13	- 2	-15.4	3,429
Columbia	26	31	- 5	-16.1	2,120
Montour	8	12	- 4	-33.3	2,064
Northumberland	42	50	- 8	-16.0	2,362
Snyder	9	7	2	28.6	3,252
Union	13	11	2	18.2	2,200
6. Capitol	608	584	24	04.1	2,073
	20	16	4	25.0	2,847
Cumberland	84	60	24	40.0	1,883
Dauphin	129	142	- 13	-09.2	1,735
Franklin	41	35	6	17.1	2,459
Lancaster	150	152	- 2	-01.3	2,131
Lebanon	42	44	- 2	-04.5	2,373
Perry	4	8	- 4	-50.0	7,154
York	138	127	11	08.6	1,975

Appendix E

Table 35
(Continued)

Region	Dentists 1970	Dentists 1960	Differences	Per Cent Change	Pop. Per Dentist 1970
7. Turnpike	233	287	- 54	-18.8	2,349
Bedford	15	14	1	07.1	2,824
Blair	58	73	- 15	-20.5	2,334
Cambria	94	123	- 29	-23.6	1,987
Fulton	3	2	- 1	-50.0	3,592
Huntingdon	17	20	- 3	-15.0	2,300
Juniata	1	3	- 2	-66.6	16,712
Mifflin	19	24	- 5	-20.8	2,383
Somerset	26	28	- 2	-07.1	2,925
8. Southwest	1,799	1,940	-141	-07.3	1,784
Allegheny	1,139	1,215	- 76	-06.3	1,409
Armstrong	30	28	2	07.1	2,520
Beaver	95	109	- 14	-12.8	2,194
Butler	53	59	- 6	-10.2	2,414
Fayette	62	84	- 22	-26.2	2,495
Greene	9	15	- 6	-40.0	4,010
Indiana	29	28	1	03.6	2,740
Lawrence	57	65	- 8	-12.3	1,884
Mercer	69	72	- 3	-04.2	1,843
Washington	83	92	- 9	-09.8	2,541
Westmoreland	173	173	0	00.0	2,179
9. North Central	47	53	- 6	-11.3	2,408
Cameron	3	4	- 1	-25.0	2,365
Elk	11	14	- 3	-21.4	3,434
McKean	28	31	- 3	-09.7	1,854
Potter	5	4	1	25.0	3,279
10. North West	283	305	- 22	-07.2	1,915
Clarion	18	20	- 2	-10.0	2,134
Crawford	41	40	1	02.5	1,984
Erie	153	165	- 12	-07.3	1,953
Forest	1	1	0	00.0	4,926
Jefferson	17	23	- 6	-26.0	2,570
Venango	29	32	- 3	-09.4	2,150
Warren	24	24	0	00.0	1,987
State Total	6,739	7,063	-324	-04.8	1,750

Note: The 10 Department of Education Planning Regions are used in this Table. The data are from Distribution of Dentists in the United States by State Region, District and County, American Dental Association, Chicago, Illinois, 1961 and 1971, p. 46ff.

Appendix F

Table 36

Rank Order of Counties By Number of Dentists, Most Favorable Population Per Dentist and Most Favorable Area Per Dentist in Pennsylvania, 1970

County	Number Dentists	Rank Order	Pop. Per Dentist	Rank Order	Sq.Mi. Per Dentist	Rank Order
Adams	20	44	2,847	53	26	34
Allegheny	1,139	2	1,409	2	0.6	4
Armstrong	30	33	2,520	45	22	28
Beaver	95	17	2,194	31	5	9.25
Bedford	15	49.5	2,824	52	68	49
Berks	161	8	1,841	10	5	9.25
Blair	58	25	2,334	36	9	15.5
Bradford	21	4	2,760	51	55	47
Bucks	174	6	2,385	41	4	7.5
Butler	53	27	2,414	42	15	22
Cambria	94	18	1,987	21.5	7	13.3
Cameron	3	61.5	2,365	38	135	54.5
Carbon	24	40.5	2,107	25	17	24
Centre	44	28	2,256	33	25	32.5
Chester	137	14	2,031	23	6	11.25
Clarion	18	46	2,134	49	33	37
Clearfield	28	36.5	2,665	48	41	42.5
Clinton	11	52.3	3,429	58	82	51
Columbia	26	38.5	2,120	26.5	19	26
Crawford	41	31.5	1,984	20	25	32.5
Cumberland	84	19	1,883	15	7	13.3
Dauphin	129	16	1,735	8	4	7.5
Delaware	414	4	1,449	3	0.4	3
Elk	11	52.3	3,434	59.5	73	50
Erie	153	4	1,953	7	5	9.25
Fayette	62	23	2,495	44	13	21
Forest	1	63.3	4,926	64	419	60
Franklin	41	31.5	2,459	43	18	25
Fulton	3	61.5	3,592	61	145	57
Greene	9	55.3	4,010	63	64	48
Huntingdon	17	47.5	2,300	34	53	46
Indiana	29	34.5	2,740	50	28	36
Jefferson	17	49.5	2,570	47	38	40.5
Juniata	1	63.3	16,712	67	386	59
Lackawanna	146	11	1,603	5	3	5.3
Lancaster	150	10	2,131	28	6	11.25
Lawrence	57	26	1,884	16	6	11.25
Lebanon	42	29.5	2,373	39	9	15.5
Lehigh	138	12.5	1,850	12	3	5.3
Luzerne	193	5	1,774	9	5	9.25
Lycoming	61	24	1,857	14	20	27
McKean	28	36.5	1,854	13	35	38
Mercer	69	21.5	1,843	11	10	17.5
Mifflin	19	45	2,383	40	23	29.5
Monroe	23	42	1,975	18.5	27	35

Appendix F

Table 36
(Continued)

	Number Dentists	Rank Order	Pop. Per Dentist	Rank Order	Sq.Mi. Per Dentist	Rank Order
Montgomery	497	1	1,255	4	0.1	2
Montour	8	57	2,064	24	16	23
Northampton	133	15	1,612	6	3	5.3
Northumberland	42	29.5	2,362	37	11	19.5
Perry	4	58.5	7,154	66	138	56
Philadelphia	1,347	3	1,447	3	.0956	1
Pike	4	59.5	2,955	55	135	54.5
Potter	5	58	3,279	57	218	58
Schuylkill	69	21.5	2,320	35	11	19.5
Snyder	9	55.3	3,252	56	36	39
Somerset	26	38.5	2,925	54	41	42.5
Sullivan	1	63.3	5,961	65	478	61
Susquehanna	10	54	3,434	59.5	83	52
Tioga	11	52.3	3,608	62	104	53
Union	13	51	2,200	32	24	31
Venango	29	34.5	2,150	29	23	29.5
Warren	24	40.5	1,987	21.5	38	40.5
Washington	83	20	2,541	46	10	17.5
Wayne	15	49.5	1,972	17	49	45
Westmoreland	173	7	2,179	30	6	11.25
Wyoming	9	55.3	2,120	26.5	44	44
York	138	12.5	1,975	18.5	7	13.3

Source of data on number of dentists in each County is Distribution of Dentists in the United States By State, Region, District and County, American Dental Association, Chicago, Ill., 1971.

Appendix G

Table 37

Total Number of Dentists, Population Per Dentist, Per Capita Buying Income by County in Pennsylvania With Rank Order, 1970

Region	Total Dentists	Population Per Dentist	Rank Order	Per Capita Buying Income[1]	Rank Order
1. Delaware Valley	2,569	1,505	1	3,604	1
Bucks	174	2,385	42	3,310	8
Chester	137	2,031	23	3,523	3
Delaware	414	1,449	4	3,800	2
Montgomery	497	1,255	1	4,386	1
Philadelphia	1,347	1,447	3	3,002	16
2. Lehigh Valley	552	1,873	4	2,906	3
Berks	161	1,841	9	3,315	6.5
Carbon	24	2,107	25	2,593	45
Lehigh	138	1,850	11	3,344	5
Monroe	23	1,975	18.5	2,877	24
Northampton	133	1,612	6	3,041	14
Pike	4	2,955	55	2,650	40
Schuylkill	69	2,320	36	2,523	51
3. Northeast	373	1,768	2	2,607	9
Lackawanna	146	1,603	5	2,659	39
Luzerne	193	1,774	8	2,643	42
Wayne	15	1,972	17	2,718	33
Wyoming	9	2,120	26.5	2,492	52
Susquehanna	10	3,434	59.5	2,524	50
4. Northern Tier	94	1,990	6	2,634	8
Bradford	21	2,760	51	2,672	37
Lycoming	61	1,857	13	2,839	26
Sullivan	1	5,961	65	2,326	56
Tioga	11	3,608	62	2,697	36
5. Susquehanna	181	2,432	10	2,639	7
Centre	44	2,256	34	2,882	23
Clearfield	28	2,665	49	2,265	62
Clinton	11	3,429	58	2,701	35
Columbia	26	2,120	26.5	2,560	47
Montour	8	2,064	24	2,541	48
Northumberland	42	2,362	38	2,515	51
Snyder	9	3,252	56	2,597	44
Union	13	2,200	33	3,054	13

Appendix G

Table 37
(continued)

Region	Total Dentists	Population Per Dentist	Rank Order	Per Capita Buying Income[1]	Rank Order
6. Capitol	608	2,073	7	2,936	2
Adams	20	2,847	53	2,646	41
Cumberland	84	1,883	14	3,463	4
Dauphin	129	1,735	7	3,247	9
Franklin	41	2,459	44	2,661	38
Lancaster	150	2,131	28	3,106	12
Lebanon	42	2,373	40	2,986	18
Perry	4	7,154	66	2,439	53
York	138	1,975	18.5	3,239	10
7. Turnpike	233	2,349	8	2,383	10
Bedford	15	2,824	52	2,525	49
Blair	58	2,334	37	2,799	29
Cambria	94	1,987	21.5	2,281	60
Fulton	3	3,592	61	2,059	67
Huntingdon	17	2,300	35	2,323	57
Juniata	1	16,712	67	2,258	63
Mifflin	19	2,383	41	2,752	31
Somerset	26	2,925	54	2,067	66
8. Southwest	1,799	1,784	3	2,687	5
Allegheny	1,139	1,409	2	3,315	6.5
Armstrong	30	2,520	46	2,587	46
Beaver	95	2,194	32	2,876	25
Butler	53	2,414	43	2,950	20
Fayette	62	2,495	45	2,078	65
Greene	9	4,010	63	2,132	64
Indiana	29	2,740	50	2,353	55
Lawrence	57	1,884	15	2,951	19
Mercer	69	1,843	10	2,820	27
Washington	83	2,541	47	2,724	32
Westmoreland	173	2,179	31	2,766	30
9. North Central	47	2,408	9	2,889	4
Cameron	3	2,365	39	3,133	11
Elk	11	3,434	59.5	2,887	22
McKean	28	1,854	12	2,939	21
Potter	5	3,279	57	2,598	43

Appendix G

Table 37
(continued)

Region	Total Dentists	Population Per Dentist	Rank Order	Per Capita Buying Income[1]	Rank Order
10. Northwest	283	1,915	5	2,651	6
Clarion	18	2,134	29	2,401	54
Crawford	41	1,984	20	2,716	34
Erie	153	1,953	16	2,998	17
Forest	1	4,926	64	2,280	61
Jefferson	17	2,570	48	2,313	58
Venango	29	2,150	30	2,813	28
Warren	24	1,987	21.5	3,034	15

[1]Source: Distribution of Dentists in the United States by State, Region, District and County, American Dental Association, Chicago, Illinois, 1971, p. 46ff. Per Capita Buying Income = income of individuals - all tax payments, p. 4.

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